NUCLEAR SCIENCE ABSTRACTS

Volume 28 Number 12

Abstracts 29572-32212

December 31, 1973

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NOTICE

A title page for Volume 28, Numbers 7–12, is included at the back of this issue for use in binding those issues.

CORRECTIONS

An incorrect journal citation, Tr. Shemakh. Astrofiz. Observ., is shown for the following abstracts: Volume 27, Abstract numbers 12244, 12805–12806, 12902, 15497–15499, 15516–15519, 15554–15555, and 15569–15577. The citation should be Tsirk. Shemakh. Astrofiz. Observ.

NSA Vol. 28, No. 5, Abst. 10685, line 4 should read: 1973).

Volume 28, Number 12, December 31, 1973

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

DIENSTBIER, Z., Effect of para-aminomethylbenzoic acid on the post-irradiation disturbance of haemocoagulation in dogs after whole-body exposure to 600 R, 27:20122
DIERCKX, R., Determination of the fast neutron spectrum at the L54 reactor core center, 27:21880
DIETZEL, H., HEOS 2 and HELIOS micrometeoroid experiments, 27:20588

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The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

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ACCELERATOR FACILITIES/DESIGN
  Design of a neutron therapy facility for a 30-inch cyclotron, 27:25413
ACETONE/RADIOLYSIS
  Pulse radiolysis of alkyl ketones, 27:24388
  Radiothermoluminescence of aliphatic ketones (Gamma radiation), 27:24389
AEROSOL GENERATORS/OPERATION
  Operating characteristics of two compressed air nebulizers used in inhalation experiments, 27:24522 (LF--45)

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Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

21102 (ORNL-4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
  Gamma-ray production due to neutron interactions with copper for incident neutron energies between 1.0 and 20 MeV: tabulated differential cross sections, 27:21102 (ORNL-4846)

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4811	**27-21462**	**Dep. NTIS, 133p.**
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4846	**27-21102**	**Dep. NTIS $4.00, 44p.**
ORNL-EIS-		
73-52(Vol. 1)(No.2)	**27-21978**	**Dep. NTIS, 13p.**
ORNL-NSF-EP-		
31	**27-22013**	**Dep. NTIS, 87p.**
32	**27-22014**	**Dep. NTIS, 83p.**
33	**27-22015**	**Dep. NTIS, 97p.**
34	**27-22016**	**Dep. NTIS, 89p.**
35	**27-22017**	**Dep. NTIS, 98p.**

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 29931, 29966, and 30495.

29572 (UCID-15644-73-2) ANALYTICAL CHEMISTRY QUARTERLY REPORT, APRIL–JUNE 1973. Harrar, J. E. (comp. and ed.). (California Univ., Livermore. Lawrence Livermore Lab.). 23 Aug 1973. Contract W-7405-eng-48. 25p. Dep. NTIS $3.25.

29573 MODERN METHODS FOR DETERMINATION OF THORIUM IN NATURAL MATERIALS. Karalova, Z. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 7, 1389-1402(Jul 1973). (In Russian).

Various analytical methods for determining thorium in natural materials are reviewed. (205 references) (auth)

Activation and Nuclear Reaction Procedures

29574 (CEA-R-4480) STUDY AND SET UP OF AN EXPERIMENTAL SYSTEM, FOR MEASURING CONCENTRATION PROFILES, USING NUCLEAR REACTIONS ANALYSIS AND SPUTTERING EFFECT: APPLICATIONS. Bruel, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Sep 1973. 157p. (In French). Dep. NTIS (U.S. Sales Only) $10.00.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

Nuclear reactions analysis may provide the spatial distribution of an impurity within a substrate. An experimental system was set up which provides the depth-distribution of the analysed element (concentration profile), through the association of the nuclear reactions analysis and the sputtering phenomenon. The method consists in alternating the two proceedings: analysis and surface etching. The vacuum problems in the target chamber and ion gun, the characteristics of the ion source were studied. The method was applied to determining concentration profiles of boron, phosphorus and oxygen in metals, semiconductors and insulating layers. (auth)

29575 (CONF-730301-P2, pp 1005-1006) PHOTO-ACTIVATION ANALYSIS AT THE NRL 60-MeV LINAC. Murray, K. M. (Naval Research Lab., Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

29576 (CONF-730301-P2, pp 1007-1008) STUDIES OF ATMOSPHERIC PARTICLE SIZE DISTRIBUTIONS USING INSTRUMENTAL PHOTON ACTIVATION ANALYSIS. Zoller, W. H. (Univ. of Maryland, College Park); Aras, N. K.; Gladney, E. S.; Lutz, G. J. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

29577 (CONF-730301-P2, pp 1009-1010) MULTIELEMENT DETERMINATION IN ENVIRONMENTAL SAMPLES BY PHOTON ACTIVATION ANALYSIS. Chattopadhyay, A.; Jervis, R. E. (Univ. of Toronto). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

29578 (CONF-730301-P2, pp 1011-1012) USE OF A 25-MeV BETATRON FOR PHOTOACTIVATION ANALYSIS IN GEOLOGY AND INORGANIC CHEMISTRY. Galatanu, V.; Grecescu, M.; Baciu, G. (Inst. for Atomic Physics, Bucharest). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

29579 (CONF-730301-P2, pp 1025) PHOTONUCLEAR ACTIVATION ANALYSIS WITH GE(Li) DETECTORS: A COMPILATION. Toms, M. E. (Naval Research Lab., Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

29580 (CONF-730301-P2, pp 1027-1028) ANALYSIS OF PURE METALS: SOME RESULTS AND NEEDED BEAM CHARACTERISTICS IN PHOTOACTIVATION ANALYSIS. Albert, P. (CNRS, Vitry, France). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

29581 (CONF-730301-P2, pp 1029-1030) APPLICATION OF PHOTONUCLEAR ACTIVATION ANALYSIS IN A COPPER MINE. Janiczek, J.; Kielsznia, R.; Olszewski, J. (Inst. of Nuclear Research, Swierk, Poland). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

29582 (CONF-730301-P2, pp 1137-1154) PHOTONUCLEAR ACTIVATION ANALYSIS. Engelmann, C. (CEN de Saclay, Gif-sur-Yvette, France). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

By far the most important application of photonuclear reactions concerns their use in analytical processes. The work published during the last few years shows the vast range of possibilities offered by γ activation. The method has been used with remarkable success for the determination of very small quantities of light elements such as carbon, nitrogen, oxygen or fluorine in highly pure substances, for which it is irreplaceable. However its field of application also extends to the measurement of many other elements, in some cases very specifically. The various methods are described and their principle outlined briefly. They are based on: direct observation of certain photonuclear reactions; photoactivation of elements by (γ, x n y p) reactions; and nuclear photoexcitation by (γ,γ′) reaction. The characteristics of these methods are described and the main work carried out to date developing γ activation analysis techniques are reviewed. (auth)

29583 (CONF-730301-P2, pp 1155-1158) PHOTON ACTIVATION OF F IN GEOLOGICAL SAMPLES. Reed, G. W. Jr. (Argonne National Lab., IL). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The nuclear, radiation and chemical factors that may cause serious errors in photoactivation of F in chondritic meteorites are discussed. In chondrites the activated F appears to become labile and may be lost. The method is applied without difficulty to terrestrial rock standards, achondrites and lunar samples,

all of which are of igneous origin. F contents of lunar samples are given and the implications regarding volatiles on the moon are discussed. (auth)

29584 (CONF-730301-P2, pp 1159-1176) PHOTON ACTIVATION ANALYSIS OF BIOLOGICAL AND ENVIRONMENTAL SAMPLES: A REVIEW. Hislop, J. S. (Atomic Energy Research Establishment, Harwell, Eng.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The reported applications of γ photon activation to the analysis of biological and environmental materials are reviewed. These are considered under the general headings; (a) determination of specific elements and (b) multi-element survey analysis. Certain practical aspects associated with the use of the technique for analysis of biological and environmental materials are also discussed. The reported applications of γ activation in this field are used to highlight the salient features of the method and an attempt is made to indicate the significance of the work reviewed and to place it in perspective with regard to alternative analytical techniques. (auth)

29585 NEUTRON ACTIVATION ANALYSIS OF ATMOSPHERIC PARTICULATES. Dale, I. M.; Duncan, H. J.; McDonald, C. (Univ. of Glasgow). Radiochem. Radioanal. Lett.; 15: No. 2, 77-86 (25 Sep 1973).

Dust samples collected from the atmosphere of a large industrial city were analyzed for sixteen elements by nondestructive neutron activation analysis. Two irradiations were required, one of 15 mins at 3×10^{12} n cm^{-2} sec^{-1} and one of 96 hours at 6×10^{12} n cm^{-2} sec^{-1}. Measurement of the induced radioactivity was carried out by using a 60 cc Ge(Li) detector coupled to a computer controlled multichannel analyzer. (auth)

29586 EXAMPLES OF USE OF HIGH-VOLTAGE ELECTROPHORESIS FOR SEPARATION OF RADIONUCLIDES. V. Activation Analysis Determination of the Abundance Ratio of the Uranium Isotopes ^{235}U and ^{238}U. Buchtela, K. (Oesterreichische Hochschule, Vienna). Radiochem. Radioanal. Lett.; 15: No. 2, 93-100 (25 Sep 1973). (In German).

Uranium samples are irradiated with thermal neutrons. Fission and irradiation products are separated by high voltage electrophoresis within a few minutes. The isotopes ^{238}U and ^{235}U are then determined by gamma spectrometry of ^{239}Np and a fission product (e.g. ^{91}Sr/^{91m}Y), respectively. (auth)

29587 DETERMINATION OF 12 RARE EARTH ELEMENTS IN LUNA-16 LUNAR SAMPLE BY NEUTRON ACTIVATION ANALYSIS. Elek, A. (Central Research Inst. for Physics, Budapest); Perneczki, G.; Szabo, E.; Dogadkin, N. N. Radiochem. Radioanal. Lett.; 15: No. 2, 123-133 (25 Sep 1973).

Twelve rare earth elements were determined in a Luna-16 lunar sample by neutron activation analysis using oxalate group precipitation and Ge(Li) gamma spectrometry. Concentration data on La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Ho, Er, Yb, and Lu in the lunar sample and in the W-1 standard rock are compared with reported values. (auth)

29588 THEORETICAL CONSIDERATIONS IN THE SELECTION OF NEUTRON SOURCES FOR TOTAL-BODY NEUTRON ACTIVATION ANALYSIS. Cohn, S. H.; Fairchild, R. G.; Shukla, K. K. (Brookhaven National Lab., Upton, NY). Phys. Med. Biol.; 18: No. 5, 648-657 (Sep 1973).

The factors involved in selecting a neutron source for total-body neutron activation (TBNAA) are the nature of the neutron source, the flux density distribution, the type and positioning of the moderator and the acceptable radiation dose to the subject. Consideration of these factors indicated that 4.5 MeV neutrons have an overall advantage of 2 relative to 14 MeV neutrons in TBNAA. Further, multiple (α,n) sources in broad beam geometry and simultaneous bilateral exposure have an advantage of 3.6 relative to 14 MeV neutrons from a neutron generator. (α,n) sources also give ease of operation and high reproducibility. (auth)

29589 RARE EARTH DETERMINATIONS BY NEUTRON ACTIVATION ANALYSIS. Steinnes, E. (Inst. for Atomenergi, Kjeller, Norway). pp 165-181 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

Advantages and disadvantages of neutron activation analysis are discussed, and the techniques used at present for the determination of rare earth elements are described. Methods based on a chemical separation of the rare earth group following the activation process, and γ-spectrometry with solid state detectors as the final step will in most cases yield high sensitivity and results of good accuracy. Purely instrumental activation analysis permits rapid analyses, and is feasible for the determination of certain rare earths in a number of matrices. Applications of thermal and fast neutron activation analysis are briefly reviewed. The analysis of rare earth matrices for traces of other rare earths is associated with particular difficulties, and requires in most cases the use of methods based on chromatographic separations. (auth)

29590 SOME EXPERIENCES ON INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF HIGH PURITY ALUMINUM AND IRON. Mamuro, T.; Mizohata, A. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 23-29 (1972).

It was attempted to apply instrumental neutron activation analysis to the determination of trace elements in high purity aluminium and iron samples. The elements, Na, Sc, Cr, Fe, Co, Zn, As, Sb, Ba, La, Ce, Sm, Tb, Lu, Hf, and Th, were determined for Al samples, and the elements, Al, V, Cu, Co, and Mn, for Fe samples. Some of the determined values were compared with those obtained by mass spectrometry elsewhere. When making activation analysis of trace elements in a high purity material by irradiation with reactor neutrons, special attention should be paid to the radioactivities produced from the matrix elements through other reactions than (n, γ). The reactions ^{27}Al(n, α) ^{24}Na and ^{56}Fe (n, p) ^{56}Mn interfere with the determinations of Na impurity in Al and Mn impurity in Fe, respectively. The determinations of Na in Al and Mn in Fe were made by irradiation with neutrons of high cadmium ratio. However, the determination of a few ppM Cr in Fe was difficult because the reaction ^{54}Fe(N, α) ^{51}Cr is induced not only by fast neutrons but also by thermal neutrons. (auth)

29591 APPLICATION OF A NONDESTRUCTIVE SINGLE-SPECTRUM PROTON ACTIVATION TECHNIQUE TO STUDY OXYGEN DIFFUSION IN ZINC OXIDE. Robin, R.; Cooper, A.R.; Heuer, A.H. (Division of Metallurgy and Materials Science, Case Western Reserve University, Cleveland, Ohio 44106). J. Appl. Phys. 44: No. 8, 3770-3777 (Aug 1973).

^{18}O diffusion coefficients were measured directly and without serial sectioning, using proton activation analysis of ^{18}O via the nuclear reaction ^{18}O (p, α)^{15}N. In this technique, the α-particle spectrum recorded during proton irradiation is used to determine the ^{18}O concentration profile; submicron resolution can be achieved. The suitability of this approach was demonstrated by studying oxygen self-diffusion along the c axis of ZnO single crystals. In the temperature range 940–1140 °C and at P_{O_2} of 700 mm, $D = 1.2(^{+1.1}_{-0.6})10^{-10} \exp[-(29.6 \pm 1.6 \text{ kcal/RT}]$ (cm^2/sec). The results are interpreted as indicating extrinsic behavior; the activation energy is then that for oxygen mobility only. The surface exchange coefficient, characteristic of the reaction between gaseous and lattice oxygen, was also determined, in the temperature range 940–1040 °C, as $K = 5.7(^{+23.8}_{-4.6})10^5 \exp[-(91.2 \pm 4.0 \text{ kcal})/\text{RT}]$ (cm/sec). A detailed analysis of the technique is presented. Using a convolution procedure, the oxygen self-diffusion coefficient, at a given temperature, is determined in a single irradiation run with a precision better than 10%, which is limited only by counting statistics. However, uncertainty in the values of the stopping powers for protons and alphas may cause an additional systematic uncertainty in D of up to ≈50%; since this error is identical for all temperatures, it causes an uncertainty in the preexponential but not in the activation energy. The technique is optimum for determining D in the range $\approx 5 \times 10^{-12}$–$\approx 5 \times 10^{-17}$ cm^2/sec and is useful for testing models of the exchange kinetics. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 29991 and 30517.

29592 (CEA-R-4439) STUDY OF THE BEHAVIOR OF SOME METALLIC CHELATES USING GASEOUS PHASE CHROMATOGRAPHY. Fontaine, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug 1973. 77p. (In French). Dep. NTIS (U. S. Sales Only) $6.00.

Thesis. Submitted to Paris Univ. (France).

The behavior of some metallic chelates derived from particular β-diaetones was investigated using chromatography: in view of defining the phenomena taking place in the column, the magnitudes of some thermodynamic parameters such as the enthalpy of the mixture, and the coefficient of activity were determined. These determinations necessitated, in addition, values of the specific retention volumes, and the saturated vapor pressure of the pure chelates. The values obtained for the coefficients of activities were generally very large and attempts were made to discover the exact nature of the phenomena intervening; a particular example is given concerning the hypothesis of a liquid-gas interface which accounts for the values observed. In this way the partition coefficient and the liquid-gas adsorption coefficient were determined. It was thus possible to determine the respective participation of

the dissolution and adsorption phenomena in the retention. The possibilities of the method are illustrated from an experiment on the separation of uranium and thorium chelates by chromatography and the quantitative determination of metals. (auth)

29593 (RDT-F-2-8-T(7-73)) QUALIFICATION AND CONTROL OF ANALYTICAL CHEMISTRY LABORATORIES FOR CONTROL ROD ABSORBER MATERIAL ANALYSIS. (Division of Reactor Research and Development (AEC), Washington, D.C.). Jul 1973. 17p. RSO.

A standard is presented that prescribes the course of action by which analytical laboratories establish their technical competence to do the chemical analyses required for the characterization of absorber material. It also provides a quality control program for the continual evaluation of the analytical data obtained during periods of absorber material production. The absorber material covered in this standard is boron carbide. (auth)

29594 DETERMINATION OF AMERICIUM BY THE METHOD OF GRAPHICAL COULOMETRY AFTER OXIDATION BY PERSULFATE. Mikhailov, V. M.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 15: No. 2, 101-106(25 Sep 1973).

Coulometric determination of microgram amounts of americium in the presence of ^{244}Cm, ^{239}Pu, Fe, and Al was investigated. The applicability of the method of graphical coulometry for analytical purposes is demonstrated. (auth)

29595 FLUORIMETRIC DETERMINATION OF HAFNIUM IN THE PRESENCE OF ZIRCONIUM BY MEANS OF QUERCETIN. Kulikov, N. S.; Granovskii, Yu. V.; Golovina, A. P. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 7, 1006-1009(1973). (In Russian).

Zirconium and hafnium form fluorescent compounds with quercetin. In concentrated $HClO_4$ only hafnium quercetinate fluoresces intensively. This property may be used for the fluorimetric determination of hafnium in the presence of zirconium. The intensity of fluorescence of the quercetinates depends on many factors: concentration of perchloric acid, ethyl alcohol, quercetin, etc. Mathematical planning of the experiments was enlisted to find the optimal conditions for the determination of Hf in the presence of Zr. The following conditions were found to be optimum: perchloric acid 8.25 molar; concentration of ethyl alcohol 8 vol. %; concentration of quercetin 4.25×10^{-5} mole/l (for a total concentration of metals equal to 2.1 micrograms/ml). The sensitivity of the hafnium determination is 0.01 micrograms/ml. The determination is possible at a concentration ratio of hafnium to zirconium of 1:200. (SJR)

29596 USE OF TERNARY COMPLEXES OF RARE EARTHS WITH GALLEINE AND CETYLTRIMETHYLAMMONIUM FOR DETERMINATION OF NEODYMIUM IN A MIXTURE WITH YTTRIUM. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 28: No. 8, 1490-1494(Aug 1973). (In Russian).

When rare earth elements form ternary complexes with galleine and cetyltrimethylammonium (CTA), their solutions have an intensive blue color. A method was developed for determining La, Ce, Pr, and Nd in a mixture with yttrium group elements the reaction being masked with 1,2-dihydroxybenzene-3,5′-disulfonic acid. The sensitivity of determination of Nd in a mixture of Nd_2O_3 and Y_2O_3 is 1 to 2% Nd_2O_3. The coefficient of variation is 3 to 11%. (auth)

29597 PHOTOMETRIC COMPLEX-FORMATION TITRATIONS OF SUBMICROMOLE AMOUNTS OF METALS. Part 3. Back Titrations. Kragten, J. (Univ., Amsterdam). Talanta; 20: No. 10, 937-946(Oct 1973).

As one aspect of the theory of photometric complex-formation titrations of submicromole amounts of metals in the presence of an approximately equivalent amount of indicator, consideration is given to the back-titration of a metal in the presence of another metal which is displaced by the titrant. The simultaneous formation of different metal-indicator complexes M_pI_q is taken into account. Titration conditions have been derived, with which optimal experimental conditions can be selected. Optimum conditions for the analysis of an indium–ytterbium alloy are deduced from the theory. (auth)

29598 FLUORIMETRIC METHOD FOR THE DETERMINATION OF LONG CHAIN AMINES IN WATER. Batley, G. E.; Florence, T. M.; Kennedy, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Talanta; 20: No. 10, 987-992(Oct 1973).

A method is presented for the determination of long-chain quaternary ammonium salts, tertiary amines and secondary amines in water or aqueous raffinates, based on their extraction and fluorimetric determination as amine salts with Eosine yellowish in toluene–hexanol (4:1) as solvent. No interferences were obtained from metal ions, or chloride, nitrate or phosphate ions when a back-washing method was applied to the sample extract. The method allows the determination of long-chain tertiary amines down to 4 ppM. (auth)

29599 KINETIC METHOD FOR DETERMINATION OF MICROGRAM AMOUNTS OF RUTHENIUM WITH AMPEROMETRIC RECORDING THE REACTION RATE. Alekseeva, I. I.; Rysev, A. P.; Yakshinskii, A. I.; Ignatova, N. K. (Moscow Inst. of Fine Chemical Tech.). Zh. Anal. Khim.; 28: No. 7, 1368-1371(Jul 1973). (In Russian).

A method is suggested for determining 5×10^{-4} to 4×10^{-2} mg Ru(IV)/ml by its catalytic action in the reaction of oxidizing iodide with hydrogen peroxide. Catalytic properties of some ruthenium complexes were studied. (auth)

29600 POLYHYDROXYFLAVONES AS EXTRACTION REAGENTS. III. EXTRACTION OF COMPLEXES OF ZIRCONIUM WITH MORIN BY ISOAMYL ALCOHOL. Blank, A. B.; Mirenskaya, I. I.; Eksperiandova, L. P. (All-Union Scientific-Research Inst. of Monocrystals, Scintillation Materials, and Special Purity Chemicals, Kharkov). Zh. Anal. Khim.; 28: No. 7, 1331-1336(Jul 1973). (In Russian).

It is shown spectrophotometrically that zirconium forms only one uncharged complex when extracted into isoamyl alcohol using morin. The ratio of the components in the complex is 1:2. Molar extinction coefficients for the complex in the organic phase, as well as its two-phase stability constant and extraction constant, were determined. A method for the extraction-photometric determination of zirconium in compounds of yttrium and rare earths was developed. (auth)

29601 USE OF COULOMETRY WITH POTENTIAL SCANNING IN ANALYTICAL CHEMISTRY. II. Determination of Plutonium. Sklyarenko, I. S.; Sentyurin, I. G.; Chubukova, T. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 7, 1318-1322(Jul 1973). (In Russian).

The behavior of Pu in media of different acids was studied by coulometry with potential scanning. Optimal conditions were developed for the determination of 1 to 100 μg Pu. The sensitivity is 0.5 μg in the sample (2×10^{-3}M). The effect of some elements on the determination of Pu was clarified. (auth)

29602 DETERMINATION OF IMPURITIES OF RARE EARTHS IN EUROPIUM OXIDE OF HIGH PURITY. Stroganova, N. S.; Ryabukhin, V. A.; Galkina, I. P.; Ermakov, A. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 7, 1313-1317(Jul 1973). (In Russian).

The kinetics of deposition of Eu (100 to 500 mg of the oxide) and microimpurities of rare earths (5×10^{-1} to 5×10^{-5}%) on a mercury cathode from citrate–acetate media was studied by the radioisotope method. Conditions were found for quantitative separation of microimpurities of rare earths including Sm. The concentration of impurities increases the sensitivity of the spectral emission method by more than an order. Europium containing $n \times 10^{-5}$% of impurities of rare earths was obtained. (auth)

29603 THREE-COMPONENT COMPLEXES OF RARE EARTH ELEMENTS OF THE YTTRIUM SUBGROUP WITH ARSENAZO III AND DIPHENYLGUANIDINE. Akhmedli, M. K.; Granovskaya, P. B.; Melikova, E. G. (Azerbaydzhan State Univ., Baku). Zh. Anal. Khim.; 28: No. 7, 1304-1312(Jul 1973). (In Russian).

The complex formation of rare earths (REE) with arsenazo III and diphenylguanidine (DPG) was studied. The formation of REE–Ar III–DPG complexes with the component ratio of 1:2:8 was found. The complexes are extracted into such solvents as alcohols by 94 to 98% in a single extraction. The color develops at once, it is resistant with respect to heating and in time. Optimal pH is 6.3 to 6.7, λ = 670 nm. An extraction-photometric method was developed for determination of REE in minerals. The error is not more than ±3%. (auth)

29604 THERMOMETRIC TITRATION IN INVESTIGATION OF THE FORMATION OF POLYANIONS OF MOLYBDENUM(VI), TUNGSTEN(VI), VANADIUM(V), AND CHROMIUM(VI). Part 1. Comparison of Thermometric and Potentiometric Titration Curves. Kiba, N.; Takeuchi, T. (Nagoya Univ., Japan). Talanta; 20: No. 9, 875-884(Sep 1973).

A new twin-cell thermometric titrator was devised and used for thermometric titration of solutions of sodium molybdate, sodium tungstate, sodium orthovanadate, ammonium metavanadate, and potassium chromate with perchloric acid. The thermometric titration curves were compared with corresponding pH-titration curves for elucidation of the reactions occurring in the titrations. Thermometric titrimetric methods were developed for the determination of tungsten, vanadium and chromium. (auth)

29605 HIGHLY SENSITIVE METHOD OF SPECTRAL ANALYSIS OF DRY RESIDUES OF SOLUTIONS USING THIN CARBON

DISCS. Bozhevol'nov, E. A.; Manova, T. G.; Silakova, V. G.; Krasil'shchik, V. Z. (All-Union Scientific-Research Inst. of Chemical Reagents and High Purity Substances, Moscow). Zh. Anal. Khim.; 28: No. 7, 1273-1279(Jul 1973). (In Russian).

A method was developed for the analysis of solutions based on the exitation of carbon discs with a dry residue of the sample in the arc discharge. An experiment was conducted to find optimal conditions for the exitation. The method developed is of highly absolute sensitivity and precision. The 22 elements determined are: Al, V, Bi, Fe, Au, Cd, Ca, Co, Si, Mg, Mn, Cu, Mo, As, Ni, Sn, Sb, Pb, Ag, Ti, Cr, and Zn. (auth)

29606 MICRODETERMINATION OF ELEMENTS BY THE METHOD OF EMISSION FLAME SPECTROPHOTOMETRY. Prudnikov, E. D.; Shapkina, Yu. S. (Leningrad State Univ.). Zh. Anal. Khim.; 28: No. 7, 1257-1261(Jul 1973). (In Russian).

Emission flame spectrophotometry can be successfully used for the microdetermination of many macro- and micro-elements in different materials. From 100% to 10^{-1} to 10^{-3}% of alkali and alkaline earth elements, Ga, In, Tl, Mn, Cr, Co, Ni, Al, Fe, Cu, Ag, Yb, Eu can be determined with high accuracy at equilibrium conditions using 1 to 10 mg samples. (auth)

29607 BISMUTHOLS AS ANALYTICAL REAGENTS. VI. Interaction of Selenium(IV) with 5-Mercapto-3-(2-naphthyl)-1,3,4-thiadiazole-2-thione and Extraction-Photometric Determination of Selenium and Tellurium Without Their Separation. Busev, A. I.; Simonova, L. N.; Misharina, T. A.; Zayukova, N. D. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 7, 1360-1364 (Jul 1973). (In Russian).

The interaction of selenium(IV) with naphthylbismuthol was studied, and acidity limits for the formation and extraction of selenium naphthylbismutholate were found. It was found by three independent methods that the molar ratio of Se : naphthylbismuthol in the complex is 1 : 4. The molar extinction coefficient of selenium (IV) naphthylbismutholate is 37×10^3 for chloroform (334 nm) and 2.27×10^3 for benzene (330 nm). A method was developed for determining selenium and tellurium without their separation using naphthylbismuthol and used for the analysis of products of volcanic activity. Down to 10^{-3}% of each element can be determined. (auth)

29608 SELECTION OF ANALYTICAL LINES FOR X-RAY SPECTRAL DETERMINATION OF SOME HEAVY ELEMENTS IN A LIGHT MAIN COMPONENT. Bozhevol'nov, E. A.; Nikolaeva, K. I.; Titova, S. A.; Nikol'skii, A. P.; Evlanov, I. Ya.; Kondratova, L. A. (All-Union Scientific-Research Inst. of Chemical Reagents and Special Purity Substances, Moscow). Zh. Anal. Khim.; 28: No. 7, 1405-1407(Jul 1973). (In Russian).

The coincidence of the calibration curves (by concentration) using the analytical lines of Pb M_α instead of Pb L_α and Cs L_α instead of Cs K_α was studied experimentally and by calculation. The determinations of lead and cesium in a light main component were used as examples. (auth)

29609 SPECTRAL ANALYSIS OF HIGH PURITY BISMUTH. Baranova, L. L.; Solodovnik, S. M.; Blokh, I. M. (Scientific-Research and Design Inst. of Rare Metal Industry, Moscow). Zh. Anal. Khim.; 28: No. 7, 1417-1419(Jul 1973). (In Russian).

A direct spectral method was developed for determining impurities of Cu, Ag, Mo, Ni, Co, Si, Pb, Sn, Cr, Mn, Au, Fe, Cd in metallic bismuth. (auth)

29610 SPECTROGRAPHIC METHOD FOR DETERMINATION OF MICROIMPURITIES OF TUNGSTEN AND MOLYBDENUM IN AMMONIUM PERRHENATE. Tarasevich, N. I.; Khlystova, A. D.; Shuvalova, E. I. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 7, 1419-1422(Jul 1973). (In Russian).

A method was developed for the spectrographic determination of 5×10^{-3}% W and 5×10^{-4}% Mo in ammonium perrhenate. The first order orthogonal experiment design was used to find optimal conditions. (auth)

29611 SPECTROPHOTOMETRIC DETERMINATION OF CADMIUM BY EXTRACTION OF CADMIUM SALT OF OXINE WITH MOLTEN NAPHTHALENE. Analysis of Metals by Solid-Liquid Separation. Fujinaga, T. (Kyoto Univ.); Satake, M.; Yonekubo, T. Bull. Chem. Soc. Jap.; 46: No. 7, 2090-2092(Jul 1973).

A method is described for the spectrophotometric determination of a minute quantity of cadmium. A cadmium complex stable at 90°C is easily extracted with melted naphthalene. The resulting mixture of cadmium complex and naphthalene is dissolved in dimethylformamide and absorbance of the solution is measured at 400 nm. Effects of pH, amounts of oxine, naphthalene and diverse salts are given. (auth)

29612 SPECTROPHOTOMETRIC DETERMINATION OF SCANDIUM AND YTTRIUM USING METHYLXYLENOL BLUE. Ueda, J. (Kanazawa Univ., Japan). Nippon Kagaku Kaishi; 1973: No. 8, 1467-1473(Aug 1973). (In Japanese).

Methylxylenol blue (MXB) reacts with scandium to form a water-soluble red-violet complex. The colored solution shows a maximum absorption at 585 nm and a constant absorbance over the pH range 2.3 to 2.7. The relation between the absorbance of the complex and the concentration of scandium is linear over the range of 0.4 to 1.6 μg Sc/ml, and the sensitivity for log (I_0/I) = 0.001 is 0.0021 μg Sc/cm^2 at concentration of 0.8 μg Sc/ml. Scandium can be determined within 5% error in the presence of twenty-six foreign ions such as rare earth elements, lead, zinc, chromium (III), manganese(II), cobalt, palladium. Indium, bismuth(III), thorium, iron(III), fluoride and oxalate interfere with the determination, but the effect of iron(III) can be eliminated by the addition of ascorbic acid. Yttrium produces a water-soluble blue complex with MXB in the presence of cetyltrimethylammonium chloride (CTMAC) and its aqueous solution has an absorption maximum between 631 and 634 nm. The coloration is stable over the pH range 6.6 to 9.3. The absorbance measured at 640 nm obeys Beer's law up to 1.8 μg/ml of yttrium. The reaction is very sensitive and the sensitivity of the determination is 0.0014 μg Y/cm^2 for log (I_0/I) = 0.001. Forty diverse ions were examined. The greater part of ions which interfere with the determination can be masked by the addition of various masking agents. Beryllium, chromium (III), rhodium(III), scandium, rare earth elements and phosphate, however, interfere seriously. Consecutive determination of scandium and yttrium was also studied. A sample solution containing scandium and yttrium is divided equally. From one solution, scandium is determined at pH 2.5 and at a wavelength 585 nm. From another solution, yttrium is determined by difference of absorbances at pH 7.5 and 640 nm, where the absorbances due to the two metal complexes are additive. (auth)

29613 DETERMINATION OF MONOBUTYL PHOSPHATE AND DIBUTYL PHOSPHATE IN TRIBUTYL PHOSPHATE. Apelblat, A.; Azoulay, D. (Israel Atomic Energy Commission, Beersheba). J. Inorg. Nucl. Chem.; 33: No. 11, 3938-3940(Nov 1973).

Siekierski (Chemia analit.; 4: 551 (1959)) proposed an indirect method for determining the total amount of monobutyl phosphate (H_2MBP) and dibutyl phosphate (HDBP) in tributyl phosphate (TBP), using the fact that $Zr(ClO_4)_4$ in 1 N $HClO_4$ is extracted by TBP only if it contains H_2MBP or HDBP. The $Zr(ClO_4)_4$ remaining in the aqueous phase is quantitatively determined by complexometric titration with EDTA. Expanding Siekierski's method a new analytical procedure is proposed which permits the separate determination of H_2MDP and HDBP in TBP, or in its mixture with hydrocarbons. Two independent equilibrations, the first with $ZrO(NO_3)_2$ and the second with $Zr(SO_4)_2$ permit quantitative analysis of the TBP phase for H_2MBP and HDBP content. Details of the new procedure are given. (UK)

29614 DETERMINATION OF MOLYBDENUM IN STEEL BY ATOMIC ABSORPTION ANALYSIS. Wada, K. (Sasebo Technical Coll., Nagasaki). Bunseki Kiki; 11: No. 2, 117-122(Feb 1973). (In Japanese).

Various methods inhibiting the interference of coexistent elements in the molybdenum determination in steel are described. The determination was performed using Hitachi 207 Type Atomic Absorption. Atomic absorption of molybdenum decreased with coexistent chrome, manganese, tungsten, aluminium, iron, magnesium, calcium, strontium, and alkaline earth metals. The decrease with alkaline earth metals was especially remarkable. In order to prevent interference, alkaline earth metal sulfates (Li_2SO_4, Na_2SO_4, K_2SO_4, Rb_2SO_4, Cs_2SO_4) were added to molybdenum solution. These salts, including previously reported Na_2SO_4, were effective in inhibiting the interference of coexistent metals. Based on these results, the molybdenum in several kinds of steel was determined. The molybdenum in low-alloy steel reached the standard amount without adding any salt, while that of high-alloy steel reached the standard by adding salt, irregardless of the composition of the steel sample. The influence of alkaline metal was inhibited by adding a solution of alkaline metal sulfate and 1,000 ppM of aluminium. Extraction methods using organic solvents by Butler and Matheus, and Kirkbright et al., were introduced as references. (JA)

Radiometric and Radiochemical Procedures

Refer also to abstracts 29827, 29856, 29908, 29909, 29940, 29946, 29989, 30530, 30705, and 31859.

29615 (JUL-955-RW) DETERMINATION OF THE RESIDUAL AMOUNT OF FISSILE METALS AND OF THE BURNUP ON SPHERICAL FUEL ELEMENTS WITH URANIUM–THORIUM-HEAVY METAL CHARGE BY MEANS OF GAMMA SPECTROSCOPIC ANALYSIS OF PROTACTINIUM-233. Duwe, R. (Kernforsch-

ungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe). May 1973. 106p. (In German). Dep. NTIS (U.S. Sales Only) $7.50.

A γ-spectroscopic method is described by means of which information can be obtained on the residual amount of fissile metals and on the burnup for AVR fuel elements with U–Th charge during continuous fueling. The procedure consists of a double measuring place with 2 separately working semiconductor [Ge(Li)] analyzers. One analyzer records the fission products ^{137}Cs and ^{140}Ba and ^{233}Pa (formed during the breeding process and which is a measure for the irradiation pattern) within a sufficient measuring time. The other one quantitatively analyzes ^{140}Ba and ^{233}Pa within 10 min. From both measurements the residual amount of fissile material can be determined. (GE)

29616 (RLO-2225-T-18-3) LONG-LIVED RADIONUCLIDES PRODUCED AT BIKINI AND ENIWETOK ATOLLS (I). Schell, W. R.; Yang, A. I. C. (Washington Univ., Seattle. Lab. of Radiation Ecology). 30 Apr 1973. 29p. Dep. NTIS $3.50.

Long-lived radionuclides were measured at Bikini and Eniwetok Atolls some 14 years after the end of major testing in the area. Techniques of separating and measuring ^{10}Be, ^{26}Al, ^{14}C, ^{55}Fe, ^{53}Mn, ^{241}Am, and $^{238,239}Pu$ in samples collected inside and near nuclear detonation craters are discussed. One of the most significant concentrations of radioactivity still present in 1972 is ^{55}Fe in Bravo crater sediments which was found to be ca. 1500 dpm/g dry. Americium-241 and ^{239}Pu were found in significant concentrations (1-60 pCi/g) in sediment and soil samples. Americium-241 measured in biota samples was found to be low, i.e., less than 0.5 pCi/g dry. The particulate ^{241}Am in water samples was found to be 5 to 70 pCi/m^3, depending on location, which indicates significant redistribution. The long-lived radionuclides can be redistributed within the lagoon; it is possible that certain radionuclides may enter into the North Equatorial Current away from Bikini Atoll. However, the amounts are generally very low and large volumes of water are required to measure the concentrations present. (auth)

29617 APPLICATION OF THE FISSION-TRACK TECHNIQUE TO THE DETERMINATION OF URANIUM IN NATURAL WATERS. Takebayashi, T.; Matsuda, H.; Umemoto, S. (Kijushu Univ., Fukuoka). Talanta; 20: No. 9, 892-895 (Sep 1973).

A procedure for the determination of the uranium content of natural waters is presented. To 100 ml of natural waters, 200 ml of concentrated hydrochloric acid are added and this solution is passed through a 6-ml column of Dowex 1-X8. The uranium is eluted with 60 ml of 0.1 M hydrochloric acid, and the eluate is evaporated to dryness. The residue is subjected to the fission-track technique described previously. The uranium content of the river waters in Fukuoka City was determined. (auth)

29618 DETERMINATION OF FALLOUT ^{137}Cs AND NATURALLY OCCURRING GAMMA-RAY EMITTERS IN SEDIMENTS. Ritchie, J. C.; McHenry, J. R. (Dept. of Agriculture, Oxford, MS). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 575-578 (Oct 1973).

With the advent of the nuclear age, a number of radionuclides were introduced into Man's natural radiation environment. Two of these radionuclides, ^{137}Cs and ^{90}Sr, are of particular interest because of their long half lives and biological importance. Research at the U. S. D. A. Sedimentation Laboratory is being conducted on the movement and redistribution of ^{137}Cs and the naturally occurring γ-ray emitting radionuclides, Th, U and K, in relation to cultural and erosional processes within watersheds. The methods used at the U. S. D. A. Sedimentation Laboratory to determine ^{137}Cs and the naturally occurring γ-ray emitters in sediments are described. (auth)

29619 QUANTITATIVE DETERMINATION OF REDUCING SUGARS, OLIGOSACCHARIDES, AND GLYCOPROTEINS WITH [^{3}H]BOROHYDRIDE. McLean, C.; Werner, D. A.; Aminoff, D. (Univ. of Michigan, Ann Arbor). Anal. Biochem.; 55: No. 1, 72-84 (Sep 1973).

A very simple and direct radioactive isotope method is described for the quantitative determination of reducing sugars. The method can be adapted to give any degree of sensitivity desired. The procedure is of general applicability to the determination of a large class of sugars. The stoichiometry of the reaction makes it a comprehensive procedure, which greatly facilitates the analysis of sugars, oligosaccharides, and glycoproteins after acid and enzymic hydrolysis. Examples of the versatility of the method are given. (auth)

29620 BASE ANALYSIS OF RIBOPOLYNUCLEOTIDES BY TRITIUM INCORPORATION FOLLOWING ANALYTICAL POLYACRYLAMIDE GEL ELECTROPHORESIS. Cia, L. L. S. Y.; Randerath, K.; Randerath, E. (Baylor Univ., Houston, TX). Anal. Biochem.; 55: No. 1, 102-113 (Sep 1973).

A procedure is described for tritium base composition analysis of major and modified constituents of 4S RNA following extraction of the RNA from analytical slab gels. Gel electrophoresis and isolation of RNA are shown not to lead to chemical alterations of RNA bases, degradation or preferential losses of RNA species. (auth)

29621 AUTOMATIC GAS COUNTER FOR QUANTITATIVE MICRO DETERMINATIONS OF TRITIUM IN BIOLOGICAL MATERIAL. Parvinen, M. (Univ. of Turku, Finland); Soini, E.; Tuohimaa, P. Anal. Biochem.; 55: No. 1, 193-200 (Sep 1973).

An automatic microcounter for quantitative determinations of tritium was developed. It has a background of 0.5 cpm and a constant and quench-free efficiency of 57.4 ± 2.1% (E^2/b 6600). Radioactivities of 2 pCi can be measured with a standard deviation of ±10% using a 1-hr counting time. It is particularly adapted for tritium microassay from biological material in which tritium is converted to a gaseous state by a single step combustion and reduction method, utilizing a mixture of metallic zinc and anhydrous sodium carbonate. Samples weighing up to 2 mg can be measured using sample ampules made of Pyrex glass with outer diameter of 5 mm and length of 30 mm. The material costs are extremely low and one technician can load and seal over 100 samples in a day. The apparatus may have significance as an additional instrument beside liquid scintillation counters in the region of radioactivities below 20 pCi. The method was successfully used in investigations concerning steroid metabolism in rat adrenal cortex and testis. Specific activities were determined from tissue samples weighing 1 μg and less. (auth)

29622 METHOD OF DIRECTLY MEASURING ^{14}C AND ^3H CONTAINED IN DIFFERENT ORGANS. Apelgot, S.; Chemama, R.; Frilley, M. (Institut du Radium, Paris). Bull. Cancer; 60: No. 1, 41-70 (1973). (In French).

The technique described permits the measurement of radioactivity (^{14}C or ^3H) contained in tissues, without previously destroying them (digestion or combustion). It is based on the fact that cellular membranes are permeables to liquid scintillators, the latter being capable of extracting certain cellular constituents. The action or an enzyme, pronase, permits the measurement, in each case, of the total radioactivity of the sample. In utilizing liquid scintillators either containing or not containing dioxane, it is possible to easily differentiate the fraction of radioactivity found in the hydrosoluble or liposoluble constituents. Preliminary tests and the study of pulse height spectra have permitted the definition of optimal measurement conditions in each case studied. The calibration curves are reproducible, and it is not necessary to determine the efficiency of each measurement. (FR)

29623 COMPARISON OF LIQUID SCINTILLATION AND GEIGER–MUELLER ESTIMATES OF PRIMARY PRODUCTIVITY IN AN IN SITU EXPERIMENT. Ward, F. J. (Univ. of Manitoba, Winnipeg). J. Fish. Res. Board Can.; 30: No. 5, 708-711 (May 1973).

For an in situ experiment conducted in Shiozu Bay, Lake Biwa, Japan, primary productivity estimates from liquid scintillation radioactivity counts of wet algae were generally higher than those from Geiger-Müller radioactivity counts of desiccated algae. Values at 0 m were similar, the G-M estimate at 0.5 m was 10% higher, but from 3 to 13 m the liquid scintillation values ranged from 11 to 33% higher than G-M estimates. The 20-m estimates were low and similar. Differences were caused primarily by ^{14}C losses during desiccation prior to G-M counting. Increasing loss rates between 0.5 and 3.0 m may have been caused by decreasing light intensity. On the basis of surface area, the estimate from liquid scintillation data was 27% greater than that obtained from G-M data. (auth)

29624 ELEMENTAL ANALYSIS OF AIRBORNE DUST BY ENERGY DISPERSIVE FLUORESCENT X-RAY SPECTROMETRY. Mizohata, A.; Mamuro, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 16-22 (1972).

A study was made to resolve some problems involved in the application of energy dispersive fluorescent x-ray spectrometry to elemental analysis of airborne dust samples collected on a membrane filter. In the attempt to determine simultaneously as many elements as possible, it should be remembered that the energy of characteristic x-rays may extend in a considerably wide range even down to 1.0 keV. In order to make accurate quantitative multielement analysis it is absolutely necessary to grasp exactly the deviation from the proportionality relation which holds in a thin specimen between the counting rate of characteristic x-rays and the mass per unit area of the corresponding element present. For the purpose of determining the method of correction for specimens of medium thickness in which the above mentioned proportionality relation does not hold, thirteen airborne dust samples, whose dust mass per unit area varied in a range from 0.2 to 7.5 mg/cm^2, were subjected to both x-ray fluorescence

analysis and instrumental neutron activation analysis, and the deviation from the proportionality was investigated. The experimental results thus obtained were compared with the theoretical relations obtained assuming appropriate absorption coefficients with dust. On the basis of these data, the twelve elements, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Br, and Pb, were determined for actual dust samples by excitation of ^{241}Am source. (auth)

29625 NUCLEAR ANALYTICAL CHEMISTRY. II. Radioactive Indicators in Chemical Analysis. Toelgyessy, J.; Varga, S. Baltimore; University Park Press (1972). 436p. $19.50.

The 6 chapters have been abstracted separately for NSA. Also included in the book are a list of abbreviations and symbols, and author and subject indexes. (JGB)

For abstracts of individual chapters see: 29626 through 29631.

29626 ANALYSIS BY MEANS OF NATURAL RADIOACTIVITY. Varga, S. pp 14-59 of Nuclear Analytical Chemistry. II. Toelgyessy, J. Baltimore; University Park Press (1972).

Methods in which the samples to be analyzed contain natural radioactive nuclides are reviewed. Emanation and detection methods are discussed. Specific methods for the determination of the following elements are reviewed: potassium, polonium, radium, radon, actinium, thorium, mesothorium, protactinium, and uranium. (396 references.) (JGB)

29627 ISOTOPE DILUTION ANALYSIS. Toelgyessy, J. pp 60-112 of Nuclear Analytical Chemistry. II. Toelgyessy, J. Baltimore; University Park Press (1972).

The following aspects of isotope dilution analysis are discussed: principles, method types (including direct, single, simple, and reverse isotope dilution analyses), sensitivity and accuracy, examples of applications, and the use of stable isotopes with the isotope dilution method. (498 references.) (auth)

29628 RADIOMETRIC TITRATIONS. Toelgyessy, J. pp 113-171 of Nuclear Analytical Chemistry. II. Toelgyessy, J. Baltimore; University Park Press (1972).

Techniques in radiometric titration, in which the end-point is determined by the use of radioactive indicators, are reviewed. Initially, only precipitation reactions were used, permitting the determination of milligram quantities. With the introduction of solvent extraction, ion exchange, chromatography, electrophoresis, and other methods of separation, along with the application of radioactive kryptonates, titration in nonaqueous medium, etc., it is possible to increase sensitivity to the micro- and submicrogram scale. Radiometric titrations based on precipitate formations, complex formation, and redox reactions and neutralization radiometric titrations are discussed in some detail. (181 references.) (JGB)

29629 RADIOREAGENT METHODS. Kyrs, M.; Krtil, J.; Toelgyessy, J. pp 172-234 of Nuclear Analytical Chemistry. II. Toelgyessy, J. Baltimore; University Park Press (1972).

In radioreagent methods, activity measurement is used to determine the amount and/or proportion of the radio-labeled substance that has reacted, which is in a certain ratio to the amount of the determined substance. Simple radioreagent methods, methods of concentration-dependent distribution, and radiorelease methods are discussed. (252 references.) (JGB)

29630 RADIOCHROMATOGRAPHY AND ELECTROPHORESIS. Toelgyessy, J. pp 235-364 of Nuclear Analytical Chemistry. II. Toelgyessy, J. Baltimore; University Park Press (1972).

Use of radiochromatographic and electrophoretic analytical-separation methods in nuclear analytical chemistry is reviewed in some detail. The principles of chromatographic methods, column (particularly ion-exchange), paper, and thin-layer radiochromatography, photoradiochromatography, and radioelectrophoresis are given. Because of certain similarities with paper chromatography, ring-oven techniques of radioactive substances are included for discussion. Within the framework of individual radiochromatographic and electrophoretic methods, a description is given of relevant equipment, methods of detection (autoradiographic, radiometric), precision, sensitivity, possibilities, and examples of their practical application. (1024 references.) (JGB)

29631 METHODICAL AND THEORETICAL STUDIES IN ANALYTICAL CHEMISTRY USING RADIOACTIVE TRACERS. Krivan, V. pp 365-419 of Nuclear Analytical Chemistry. II. Toelgyessy, J. Baltimore; University Park Press (1972).

The use of radionuclides as indicators is discussed under the following section headings: use of radioactive indicators for the determination of the solubility of sparingly soluble substances; adsorption on glass and other materials; study of precipitation and co-precipitation by radioactive indicator method; investigation of electrochemical methods; investigation of distillation methods; investigation of methods based on ion exchange; use of radioactive tracers in the investigation of extraction methods; and, use of radioactive tracers in the solving of other analytical problems. (462 references.) (JGB)

Separation Procedures

29632 (FRNC-R-19, pp 110-111) RADIOTOXICOLOGICAL CONTROL OF PERSONNEL: RAPID SEPARATION OF RARE EARTHS AND ALKALINE EARTHS ON ION EXCHANGE RESINS. Quentric, Y.; Bouquet, G.; Rocquet, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The behavior of fission products and their separation is a very important problem for the personnel handling such substances. The usual method employed for separation involves a cation resin column and utilizes a pH gradient that enables selective elution of the radioisotopes to be made as a function of time and thus as a function of pH. This technique is time consuming and a simpler more rapid technique was subsequently developed. This new technique consists of finding a pH value suitable for the separation of the rare earths from calcium and strontium. This new technique was applied to a large number of samples and enabled the radiochemical yields of this analysis to be determined for promethium, yttrium, cerium, calcium, and strontium. (FR)

29633 MOLYBDENUM SORPTION FROM SEAWATER BY FERRIC HYDROXIDE. Barannik, V. P.; Zhorov, V. A.; Sovga, O. S. (Moscow Inst. of Power Physics). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 8, 737-739(Aug 1973). (In Ukrainian).

Molybdenum dissolved in seawater is sorbed quantitatively by ferric hydroxide. The maximum sorption was found to take place at pH 2 to 4, as pH increases, the sorption decreases, reaching its minimum at pH 8.5. The coprecipitation of molybdenum with ferric hydroxide is influenced by the amount of adsorbent, duration of their contact, as well as by molybdenum concentrations. Optimum conditions for molybdenum sorption from seawater by ferric hydroxide were established. (auth)

29634 DISTRIBUTION OF IMPURITIES IN THE PREPARATION OF HIGH PURITY MAGNESIUM SALTS. Debska-Horecka, A. (Technical Univ., Gliwice, Poland); Stronski, I. Radiochem. Radioanal. Lett.; 15: No. 2, 87-91(25 Sep 1973).

Investigations on the separation of trace amounts of Ba, Mn, Fe, Sr + Y, Co, Ca, Zn, Ag, and Na, from macroamounts of Mg are described. Test results show that in the presence of the complexing agent EDTA the impurities investigated, i.e. Ca, Mn, Fe, Co, Ni, Zn, Sr + Y, Na, Ag, and Ba practically do not coprecipitate with magnesium carbonate. It was also found that, as a result of applying magnesium 8-hydroxyquinolinate as carrier, it is possible to remove completely Mn, Fe, Ni, Zn, and partly also Co and Ag from the magnesium salt solution. (DHM)

29635 THERMODYNAMICS OF EXTRACTION EQUILIBRIA. II. Extraction of Uranyl Nitrate and Chloride With Trioctylphosphine Oxide. Petkovic, D. M.; Ruvarac, A. L.; Konstantinovic, J. M.; Trujic, V. K. (Institut za Nuklearne Nauke Boris Kidric, Belgrade). J. Chem. Soc., Dalton Trans.; No. 16, 1649-1653(1973).

Thermodynamic equilibrium constants of extraction of nitric ($K = 6.0 \pm 0.6$) and hydrochloric acid [$K = (2.5 \pm 0.2) \times 10^{-3}$] and uranyl nitrate [$K = (1.0 \pm 0.1) \times 10^{5}$] and chloride [$K = (6.0 \pm 0.6) \times 10^{2}$] with trioctylphosphine oxide in carbon tetrachloride were determined. (auth)

29636 SEPARATION OF MOLYBDENUM FROM INTERFERING ELEMENTS BY EXTRACTION AS PHOSPHOMOLYBDENUM BLUE. Yatirajam, V.; Ram, J. (Kurukshetra Univ., India). Talanta; 20: No. 9, 885-890(Sep 1973).

A simple method is described for the separation of molybdenum from titanium, zirconium, chromium, manganese, iron, cobalt, nickel, uranium, and aluminium in a wide variety of samples in <30 min. Phosphomolybdenum blue is produced by boiling for 2 min a molybdate solution containing phosphate to give Mo/P = 20 to 37 (w/w) with hydrazine sulphate in 0.1 N sulphuric acid. The volume and acidity are adjusted to give a molybdenum concentration of 0.6 to 5 mg/ml in 0.4 to 0.5 N sulphuric acid. The phosphomolybdenum blue is 99.5% extracted with methyl isobutyl ketone in a single extraction. The residual molybdenum and hydrazine in the aqueous phase are oxidized with a few drops of liquid bromine and the molybdenum is quantitatively extracted with the same solvent from 1 N sulphuric acid as its reddish brown thiosulphato complex. The molybdenum is stripped by ammonia-hydrogen peroxide solution. The back-extract is heated to boiling and filtered to remove the insoluble hydroxides of traces of accompanying elements. The thiosulphate in the filtrate is destroyed by boiling for 4 to 5 min with excess of hydrogen peroxide in slightly ammoniacal medium. The molybdenum is determined finally by cerimetry or other standard methods. (auth)

29637 REDUCTION OF NIOBIUM PENTACHLORIDE IN AN ARGON-HYDROGEN PLASMA. Ivanov, O. R.; Matytsin, A. P. (Inst. of High Temperatures, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 156-157(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 178-179(1973).

In connection with the development of the chlorine method of extraction of niobium from ores, intense interest attaches to processes of reduction of niobium pentachloride with hydrogen. An investigation is reported of the process of the reduction of niobium pentachloride by a plasma-chemical method, permitting a substantial increase in the rate of chemical reactions. Results show that the degree of conversion of the pentachloride to niobium increased with increasing hydrogen content in the plasma-forming gas from 5.9 to 13.2%; however, further increasing the hydrogen concentration to 20.3% led to a decrease in the degree of conversion. (DHM)

29638 ION-EXCHANGE SEPARATIONS ON MIXED COLUMNS. Yamabe, T. (Tokyo Univ.). J. Chromatogr.; 83: 59-65(29 Aug 1973).

The separation of metal ions by elution with a solution containing a chelate-forming agent, namely an organic hydroxy acid (lactic acid or tartaric acid) was investigated by changing the mixing ratio (γ) of the cation- and anion-exchange resins and by changing the pH of the eluent. When the concentration of lactic acid was 0.5 M at pH 2.8 and $\gamma = 1/2$, a mixed sample of Lu, Tm, Er, Ho, Dy, Tb, and Gd was completely separated within 100 min. When the concentration of tartaric acid was 0.25 M at pH 3.0 and $\gamma = 2$, a mixed sample of Cu, Zn, Pb, Co, and Cd was completely separated within 90 min. (auth)

29639 SEPARATION OF TIN(II) FROM ACCOMPANYING METALS BY SOLVENT EXTRACTION WITH BIS(2-ETHYLHEXYL) THIOPHOSPHORIC ACID. Levin, I. S.; Tarasova, V. A. (Inst. of Physical-Chemical Principles of Processing Mineral Raw Materials, Novosibirsk, USSR). Zh. Anal. Khim.; 28: No. 7, 1341-1345 (Jul 1973). (In Russian).

Tin can be separated from alkali, alkaline earth, and rare earth metals, Cu, As(III), Bi, Sb(III), Ga, Al, Zr, Ti, Hg, Co, Ni, Tl(I) by its extraction with bis(2-ethylhexyl)thiophosphate from sulfuric, hydrochloric, and perchloric acid media. Methods were developed for the determination of microamounts of tin in ores and other materials. (auth)

29640 EXTRACTION CONSTANTS AND TWO-PHASE STABILITY CONSTANTS FOR MOLYBDENUM(VI) AND VANADIUM(IV) PYRAZOLINEDITHIOCARBAMINATES. Byr'ko, V. M.; Polinskaya, M. B.; Busev, A. I. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 7, 1365-1367(Jul 1973). (In Russian).

Exchange reactions of molybdenum (VI) 3-phenyl-, 5-phenyl- and 3,5-diphenylpyrazolinedithiocarbaminates in $CHCl_3$ with nickel ions in the aqueous phase and vanadium (IV) pyrazolinedithiocarbaminate with lead ions were studied. Equilibrium constants for the reactions were determined, and extraction constants and two-phase stability constants for these compounds were calculated. (auth)

29641 VARIATION OF EXTRACTION STRENGTH IN HOMOLOGOUS SERIES OF OXO SOLVENTS. Manko, R.; Soczewinski, E. (Inst. of Chemistry, Lublin). Rocz. Chem.; 47: No. 6, 1265-1273(1973). (In Polish).

Relationship between the R_M values of several metals and the concentration of active groups of organic extractant was investigated for systems of the type oxo solvent–aqueous electrolyte solution using paper partition chromatography with controlled amount of the stationary phase. It has been shown that the extraction strength of oxo solvents depends on the composition and structure of extracted metal complexes as well as on the type and concentration of active groups in the oxo solvent. Differences in extraction strengths of homologous series of alcohols, ketones and esters were found, the R_M values being linearly dependent on the concentration of active groups (in logarithmic scale). The experimental results indicate also that the molecular shape of the oxo solvent plays a significant role which is, probably, caused by differentiated accessibility to the coordination sphere of the metal ion. (auth)

29642 SELECTIVITY OF THE EXCHANGE OF CERTAIN CHLORO COMPLEXES ON ANION-EXCHANGE RESINS. Zakharova, N. S.; Chaschina, O. V.; Kataev, G. A. (Tomsk State Univ., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 3, 377-378 (Mar 1973).

Translated from Zh. Fiz. Khim.; 47: No. 3, 674-676(Mar 1973).

The adsorption of the complex ions $TeCl_6^{2-}$ and $CuCl_4^{2-}$ by AV-17 ion-exchange resin with 2, 8, 10, and 16% DVB was investigated. $TeCl_6^{2-}$ ions are sorbed by the anion exchanger from 10 N HCl solutions, more effectively than $CuCl_4^{2-}$ ions, according to different interactions of the complex ions with hydrogen ions in the outer sphere and the difference between the tendencies of the ions to form ionic association complexes within the resin. (auth)

29643 RAPID RARE EARTH SEPARATION BY PRESSURIZED ION EXCHANGE CHROMATOGRAPHY. Campbell, D. O. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 33: No. 11, 3911-3919(Nov 1973).

The use of pressurized ion exchange chromatography for the rapid separation of all the rare earth elements was demonstrated. With Dowex 50W-X8 ion exchange resin and a concentration gradient of α-hydroxyisobutyrate solution, quantitative separations were achieved in 1 to 2 hr when rare earths loadings were several per cent of the resin capacity. The results indicate that scale-up to industrial production rates is practical. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 30489 and 31482.

Chemical and Physicochemical Properties

Refer also to abstracts 29643, 29743, 30405, 30486, 32154, 32165, 32169, and 32189.

29644 (ORNL-TM-3259) ENGINEERING DEVELOPMENT STUDIES FOR MOLTEN-SALT BREEDER REACTOR PROCESSING NO. 9. McNeese, L. E. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 282p. Dep. NTIS $16.25.

Research progress is reported in the following areas: isolation of Pa by oxide precipitation; reference processing plant flowsheet based on fluorination, reductive extraction, and the metal transfer process; importance of U inventory in an MSBR processing plant; removal of rare earth fission products from LiCl in the metal transfer process; experiments on induction heating in a continuous fluorinator simulation; predicted corrosion rates in continuous fluorinators employing frozen-wall protection; predicted performance of continuous fluorinators; measurement of axial dispersion coefficients and gas holdup in open bubble columns, semicontinuous reduction extraction experiments in a mild steel facility; development of the metal transfer process: operation of experiment MTE-2 and MTE-3; development of mechanically agitated salt–metal contactors; hydrodynamics of packed column operation with high-density fluids; analysis of multicomponent mass transfer between molten salts and liquid bismuth during countercurrent flow in packed columns; and study of the purification of salt by continuous methods. (DHM)

29645 X-RAY AND NEUTRON DIFFRACTION FROM WATER AND AQUEOUS SOLUTIONS. Narten, A. H. (Oak Ridge National Lab., TN). (1973). vp.

From international symposium on structure of water and aqueous solutions; Marburg, Germany (19 Jul 1973).

Diffraction experiments using x-rays or thermal neutrons, their accuracy and efficiency for monoatomic liquids and polyatomic liquids such as water are described. The x-ray scattering amplitudes of O, D, and H contrast sharply with corresponding neutron scattering amplitudes. X-ray diffraction data on water and neutron diffraction data on D_2O have yielded weighted average structure and correlation functions for OD and DD interactions. Some examples of neutron diffraction applied to ionic solutions ($LiCl/H_2O$, $LiCl/D_2O$, HCl/H_2O, DCl/D_2O) are given. (GE)

29646 SYSTEMIZATION OF EFFECTIVE IONIC CHARGES IN OXIDES, OXYFLUORIDES, AND FLUORIDES OF RARE EARTHS. Batsanov, S. S.; Dulepov, E. V. Zh. Strukt. Khim.; 14: No. 3, 541-547(1973). (In Russian).

An analysis is given of the ir absorption spectra of powdered rare earth compounds on the basis of optical data from the corresponding monocrystalline compound. With the use of the Lidden–Sax–Teller theory, it was possible to determine vector and space-averaged values of the dielectric penetrabilities. From these data the method of Szigeti was used to calculate values of the effective charge of atoms in the rare earth oxides, oxyfluorides, and fluorides. Values of the effective charge e* for the cubic (or pseudocubic) modifications of Ln_2O_3, LnOF, and LnF_3 were equal, respectively, to 0.65, 0.76, and 0.76 e; for the anisotropic modifications the values were respectively, 0.59, 0.69, and 0.72 e. A decrease in effective charge during a phase transformation was interpreted by taking into account the structural details of the coordination polyhedron. (SJR)

Isotope Effects

29647 ISOTOPE EFFECTS AND HYDRATE STRUCTURE OF AQUEOUS ELECTROLYTE SOLUTIONS. Heinzinger, K. (Max-Planck Institut fuer Chemie, Mainz). (1973). vp.

From international symposium on structure of water and aqueous solutions; Marburg, Germany (19 Jul 1973).

The Taube CO_2-equilibration method was applied to measure the oxygen isotope fractionation in aqueous solutions of $CuSO_4$ and $CuCl_2$. The measured concentration dependence of the fractionation factor, delta, does not show the linearity observed by Taube, and for this reason an additional dependence on the anion could be assumed. Therefore, detailed studies of KCl, KBr, KI in H_2O and D_2O were performed. The results show an anion dependence which is weak in H_2O but remarkably high in D_2O. However, measured isotope effects in different chlorides (LiCl, NaCl, KCl, CsCl) dissolved in H_2O and D_2O, respectively, make it clear that the solvent isotope effect is not only accomplished by the influence of the anion on the structure of the free water alone, but also by a change of the force constants in the hydrate complex caused by the solvent. This may be a result of the different dipole moment or it may be the result of a different strength of the hydrogen bonds between the hydration water of the cation and the water of the second hydration sphere. (GE)

29648 UREY-BRADLEY FORCE FIELDS OF CHLORYL FLUORIDES. So, S. P.; Chau, F. T. (Chinese Univ., Hong Kong). Z. Phys. Chem. (Frankfurt); 84: No. 5-6, 241-254(1973).

The force constants of the six isotopic chloryl fluorides $^{35}Cl^{16}O_2F$, $^{37}Cl^{16}O_2F$, $^{35}Cl^{18}O_2F$, $^{37}Cl^{18}O_2F$, $^{35}Cl^{16}O^{18}OF$, and $^{37}Cl^{16}O^{18}OF$ in the simple and various modified Urey–Bradley force fields were calculated using published fundamental frequencies. The analysis was carried out within Wilson's FG formalism and the constants were evaluated by a computer program based on the least-squares-fit method. The normal coordinates and the potential energy distributions were also determined. (GE)

29649 PHOTOCHEMISTRY OF AROMATIC NITRO COMPOUNDS. VII. Photolysis of β-Deuterated 1-Tert-Butyl-2 Nitrobenzenes. Doepp, D.; Brugger, E. (Karlsruhe Univ., Ger.). Chem. Ber.; 106: No. 7, 2166-2173(1973). (In German).

Photolysis of β-deuterated 1-tert-butyl-2-nitrobenzenes in methanol occurs without loss of isotopic label both in recovered starting material and products. The product as well as recovered starting material from irradiation of 1,4-di-tert-butyl-2-nitrobenzene in methanol-od does not show any deuterium incorporation. Both results demonstrate that the diradical does not return to the initial substance but rapidly cyclizes. A methyl group of the side chain is attacked by the excited nitro group 4.1 to 4.8 times faster than is a trideuteriomethyl group. (GE)

29650 DIBENZYL ($^{12}CH_2{}^{13}CH_2$) SULPHOXIDE. An Example of Optical Activity Due to Isotopic Dissymmetry of Carbon. Andersen, K. K. (New Hampshire Univ., Durham); Colonna, S.; Stirling, C. J. M. J. Chem. Soc., Chem. Commun.; No. 18, 645-646(19 Sep 1973).

(R)-Dibenzyl sulphoxide ($Ph^{12}CH_2SO^{13}CH_2Ph$), $[\alpha]_{289} = +0.71$, was obtained by treatment of (R)-(+)-menthyl toluene-ω-sulphinate with $Ph^{13}CH_2MgCl$ and converted into the enantiomer by O-alkylation and hydrolysis. (auth)

29651 DEUTERIUM ISOTOPE EFFECTS ON ^{13}C CHEMICAL SHIFTS IN LONG-CHAIN ALIPHATIC COMPOUNDS. Tulloch, A. P.; Mazurek, M. (National Research Council of Canada, Saskatoon, Saskatchewan). J. Chem. Soc., Chem. Commun.; No. 18, 692-693(19 Sep 1973).

After introduction of one or more deuterium atoms into long-chain aliphatic compounds there are measurable upfield shifts of β- and γ-carbon NMR signals and also marked increases in line width probably due to long range ^{13}C-D coupling. (auth)

29652 EFFECT OF THE ADDITION OF ALKALI METAL CHLORIDES AND TEMPERATURE ON THE STRUCTURE OF ORDINARY AND HEAVY WATER. Shraiber, L. S.; Tikhii, S. P. (Saratov State Univ., USSR). Russ. J. Phys. Chem (Engl. Transl.); 47: No. 3, 392-393(Mar 1973).

Translated from Zh. Fiz. Khim.; 47: No. 3, 698-699(Mar 1973).

The results of accurate measurements of the densities of dilute solutions of alkali metal salts in ordinary and heavy water and of the temperature coefficient of volume expansion in the range 10 to 70°C are presented. It was shown on the basis of experimental results that the addition of a salt (as well as temperature) tends to disrupt the structures of both solvents up to 40 to 50°C. It was confirmed again that heavy water has a more distinctive structure than ordinary water. (auth)

29653 NATURE OF MOLECULAR HYDROGEN ADSORBED ON ZINC OXIDE. Chang, C. C.; Dixon, L. T.; Kokes, R. J. (Johns Hopkins Univ., Baltimore). J. Phys. Chem.; 77: No. 22, 2634-2640(25 Oct 1973).

The reversibly adsorbed hydrogen and deuterium on zinc oxide at −195 and −183°C (type III) was examined by adsorption and ir techniques. The isotherms show a significant isotope effect and yield isosteric heats at low coverage of 2.2 to 2.5 kcal. Infrared studies and the temperature and pressure dependence show this hydrogen is present in molecular form and is limited to 5 to 10% of the surface. Poisoning studies with water suggest it occurs on the same sites as the dissociative type I hydrogen. Interpretation of the spectral results and the isotope effect suggest that there is a considerable barrier to rotation on the surface. The possible role of such a species in the ortho–para hydrogen conversion is discussed. (auth)

29654 KINETICS AND MECHANISM OF THE REACTION OF GRIGNARD REAGENTS WITH KETONES. Rudolph, S. E.; Charbonneau, L. F.; Smith, S. G. (Univ. of Illinois, Urbana). J. Amer. Chem. Soc.; 95: No. 21, 7083-7093(17 Oct 1973).

The kinetics of the reaction of 4-methylmercaptoacetophenone with cyclopentylmagnesium reagents, measured by stopped-flow uv and ir spectroscopy in the presence of excess organomagnesium reagent, indicate that, under these conditions, the reaction is first order in ketone, but that the kinetic order in organomagnesium approaches one in dilute solution and zero at high concentration, which corresponds to a mechanism involving complex formation between the reactants. Addition of $MgBr_2$ to 0.15 M dicyclopentylmagnesium depresses the observed first-order rate constant from 405 (0.002 M bromide) to 1.3 sec^{-1} (0.84 M bromide). The kinetics and products are consistent with both $(C_5H_9)_2Mg$ and C_5H_9MgBr contributing to the reactions, with a relative contribution which is a sensitive function of the concentration of magnesium bromide. The rate level with the deuterated reagent, 2,2,5,5-tetradeuteriocyclopentylmagnesium bromide, corresponds to a k_H/k_D of 2.0 for the reduction component of the reaction. (auth)

29655 ISOTOPE AND MASS WEIGHTING EFFECTS IN COLLINEAR TRIATOMIC REACTIVE COLLISIONS. Miller, C.G. (Department of Chemistry, University of Calgary, Calgary, Alberta, Canada). J. Chem. Phys. 59: No. 1, 267-274 (1 July 1973).

A one-dimensional quantum mechanical reaction coordinate method has been developed by Rankin and Light and Miller and Light to study vibrational excitation of product molecules in reactive triatomic collinears collisions. In this paper the method is extended to study the isotopic reactions $H+Cl_2 \rightarrow HCl+Cl$ and $D+Cl_2 \rightarrow DCl+Cl$. The observed results showed there is no change in the mean fraction of available energy entering product vibration. This is in agreement with previous experimental and classical trajectory study findings. The method is further used to study a reaction with a much different mass combination $Cl+HI \rightarrow HCl+I$. We expect this reaction, from classical trajectory studies, to exhibit primarily "mixed" energy release. Also from classical studies, the different mass combinations for the reaction $H+Cl_2 \rightarrow HCl+Cl$ and the reaction $Cl+HI \rightarrow HCl+I$ are expected to lead to significantly different reaction dynamics. The one-dimensional quantum mechanical results are consistent with the classical results. (auth)

29656 VIBRATIONAL RELAXATION OF HYDROGEN AND DEUTERIUM FLUORIDES. Hinchen, J.J. (United Aircraft Research Laboratories, East Hartford, Connecticut 06108). J. Chem. Phys. 59: No. 1, 233-240 (1 July 1973).

The vibrational relaxation of HF and DF has been studied using the laser fluorescence technique at 295°K. Rates were determined for self-relaxation of HF and DF and also for cross relaxation through transfer of vibrational energy between these molecules. The results are compared with relaxation of the isotopic combinations in HCl/DCl and HBr/DBr, and discussed with reference to the Moore and the Shin theories. Results are also given for the rates of vibrational energy transfer between DF–D_2 and HF–H_2 and for the relaxation of DF by Ar, He, H_2, and N_2 and for HF by Ar and He. (auth)

29657 TEMPERATURE DEPENDENCE OF THE VIBRATIONAL ENERGY DISTRIBUTIONS IN THE REACTIONS $F + H_2$ AND $F + D_2$. Coombe, R.D.; Pimentel, G.C. (Chemistry Department, University of California, Berkeley, California 94720). J. Chem. Phys. 59: No. 1, 251-257 (1 July 1973).

Using chemical laser methods, the behavior of the product vibrational distributions in the reactions $F + H_2 \rightarrow HF + H$ and $F + D_2 \rightarrow DF + D$ has been studied as a function of reactant temperature. Both the equal-gain and zero-gain techniques were employed. In the $F + H_2$ system, k_3/k_2 and k_2/k_1 increase as temperature decreases, k_2/k_1 showing a much stronger dependence than k_3/k_2. Both the k_3/k_2 and k_2/k_1 temperature dependences fit an Arrhenius-type form, $k_3/k_2 = 0.39 \exp(+117/RT)$ and $k_2/k_1 = 2.14 \exp(+254/RT)$. An opposite behavior is observed for the $F + D_2$ system: k_3/k_2 rises with increasing temperature. These results provide the first quantitative evidence that reaction product vibrational distributions are temperature dependent and they demonstrate the applicability of chemical lasers to such measurements. (auth)

Isotope Exchange and Isotope Separation

29658 RADIOACTIVE IODINE EXCHANGE AND THE DUSHMAN REACTION. Furuichi, R.; Liebhafsky, H. A. (Texas A and M Univ., College Station). Bull. Chem. Soc. Jap.; 46: No. 7, 2008-2010(Jul 1973).

Critical studies were made on the Dushman reaction, $6H^+ + 5I^- + IO_3^- = 3I_2 + 3H_2O$. Rate measurements of radioactive iodine exchange away from chemical equilibrium gave results which made the rate law for the Dushman reaction doubtful. Measurements of $d(H^+)/dt$ confirmed the rate law. The contrary interpretation resulted because existing chemical information was not considered. This situation holds in many radioactive iodine exchange experiments done on the Dushman reaction. (auth)

29659 SURFACE TENSION OF SATURATED ANHYDROUS HYDROGEN SULFIDE AND THE EFFECT OF HYDROGEN SULFIDE PRESSURE ON THE SURFACE TENSION OF WATER. Herrick, C. S.; Gaines, G. L. Jr. (General Electric Corp., Schenectady, NY). J. Phys. Chem.; 77: No. 22, 2703-2707 (25 Oct 1973).

In the GS process for enriching the deuterium content of natural waters, liquid water and gaseous H_2S under pressure are contacted on a large scale and therefore, surface properties probably play an important role. The surface tension of anhydrous liquid H_2S in the temperature range 25 to 40° varies from 11.3 to 8.7 dyn/cm. The Guggenheim equation fits these data precisely. Measurements of the surface tension of water in contact with H_2S at pressures up to 300 psi and from 25 to 40° show that H_2S causes a greater reduction in surface tension with pressure than any gases previously studied. The data for H_2S and for other gases suggest that the maximum lowering of surface tension corresponds to the adsorption of one close packed monolayer of gas molecules on the water surface. H_2S and CO_2 reach monolayer adsorption at about ½ saturation pressure. In general, this behavior may permit order-of-magnitude prediction of surface tension effects from values of the pressure required for phase change. An estimate was also obtained for the contact angle of H_2S-saturated water on the solid H_2S hydrate. (auth)

29660 RAPID DEUTERIUM AND TRITIUM LABELLING OF AROMATIC COMPOUNDS USING ALKYL-ALUMINIUM DIHALIDE CATALYSTS. Competing Rearrangement of Polysubstituted Aromatics. Garnett, J. L.; Long, M. A.; Vining, R. F. W. (Univ. of New South Wales, Kensington, Australia). Tetrahedron Lett.; 41, 4075-4078(Oct 1973).

A wide range of metal halide catalysts have been found to catalyze deuterium and tritium labelling of aromatic compounds, the most thoroughly investigated being the organoaluminium dihalides. It is now reported that during the labelling of some disubstituted benzenes accompanying rearrangement of aromatic substituents was observed, and it is stated caution is necessary in the application of the labelling technique to such classes of compounds. Thus, in the deuteration of the xylenes using benzene-d_6 as source of isotope, in addition to labelling of the xylene, the xylenes may isomerise, or intermolecular migration of CH_3 to the benzene-d_6 to yield toluene may occur. Further examples are given. (UK)

29661 SEPARATION OF BORON ISOTOPES USING A STRONG BASE EXCHANGE RESIN IN FLUORIDE FORM. Hirao, T. (Tokyo Inst. of Tech.); Kotaka, M.; Kakihana, H. Nippon Kagaku Kaishi; 1973: No. 8, 1477-1481(Aug 1973). (In Japanese).

Boric acid solution (0.1 mol/l) was passed through a column packed with a strong base anion exchange resin, Diaion SA 20A in the fluoride form (0.8 $cm^2 \times 45$ cm or 0.8 $cm^2 \times 95$ cm bed), and the band formed on the column was eluted with pure water. The boric acid concentration in each fraction of the effluent was determined by the acid–base titration with manitol. The atomic fraction of ^{10}B in each fraction was determined by means of a Varian Mat CH5 mass spectrometer, using the surface ionization method. In these experiments, it was found that ^{10}B was considerably enriched in the rear part of the band (e.g. $\alpha^r = 1.06$) and depleted in the frontal part (e.g. $\alpha^f = 0.95$). The boric acid charged on the column was nearly completely eluted with pure water. Fluoride ion was scarcely detected in the effluent (below 10^{-3} mole/l). The elution curve became sharper with a decrease of flow rate. The enriched amount of ^{10}B increased with a decrease of flow rate, and with an elevation of column length and loading of boric acid. (auth)

Feed Materials Processing

Refer also to abstracts 29726 and 29826.

29662 URANIUM ENRICHMENT DURING GEOLOGICAL PROCESSES AND DURING ORE PROCESSING. Fuchs, H. D. (Urangesellschaft mbH und Co. KG, Frankfurt am Main); Geier, H. Chem. Ztg.; 97: No. 6, 304-311(1973). (In German).

Present ideas of the more important geological factors for uranium concentrations during the formation of uranium ore deposits are summarized. The state of uranium ore processing technology is considered as well as the production of uranium concentrate including investment and production costs. (auth)

29663 LESS HANDS IN URANIUM EXTRACTION. Sommer, G. Nucl. Active; 15-19(Jul 1973).

Much has been said and written about the extraction and refinement of uranium in South Africa during the last ten years. The research work involved has largely been done by the National Institute for Metallurgy for the Extraction Metallurgy Division of the Atomic Energy Board. The technological and economic improvements achieved in methods of extraction have introduced instrumentation and automation to local uranium processing plants, and some of the instrumentation developed at NIM is described. (auth)

Radiation Chemistry

Refer also to abstracts 30017, 30020, 30045, 30147, 30678, and 30688.

29664 (CONF-730301-P2, pp 1107-1122) TECHNIQUES IN PULSE RADIOLYSIS. Graetzel, M.; Thomas, J. K. (Univ. of Notre Dame, IN). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The fundamental physical and chemical processes that occur in radiation chemistry are outlined. The short lifetime of the chemical intermediates is emphasized to draw attention to the necessity of rapid time response in any pulse radiolytic system. The nature or type of the radiation used in pulse radiolysis is discussed; the advantages of fast electrons being emphasized. The descriptions of several pulse radiolysis systems in the psec, nsec, μsec and longer ranges are given and in particular the following detection techniques are described: absorption and emission spectroscopy, conductivity, polarography and ESR. Examples of data from these systems are given and their relevance to radiation and physical chemistry briefly discussed. (auth)

29665 (COO-38-759) SELECTED SPECIFIC RATES OF REACTIONS OF TRANSIENTS FROM WATER IN AQUEOUS SOLUTION. 1. Hydrated Electron. Anbar, M.; Bambenek, M.; Ross, A. B. (Stanford Research Inst., Menlo Park, Calif.; Notre Dame Univ., Ind. Radiation Lab.). May 1973. 67p. (NSRDS-NBS-43). GPO $0.90.

Rates of reactions of hydrated electrons with over 700 different organic and inorganic molecules, ions, and transients have been tabulated. Most of the data are derived from pulse radiolysis of aqueous solutions; results from photolysis and from steady-state radiolysis by competition kinetics are also included. (auth)

29666 (COO-584-52) TECHNICAL PROGRESS REPORT, NOVEMBER 15, 1972–NOVEMBER 14, 1973. Moser, H. C.; Isaacs, T.; Johnson, C.; Jones, T. (Kansas State Univ., Manhattan. Dept. of Chemistry). 1973. Contract AT(11-1)-584. 8p. Dep. NTIS $3.00.

Research progress is reported in the following areas: thin-film cathodes for use in low-energy electron radiolysis; reactions of discharge produced tritium species with solid films of propene, and Cis, and Trans-2-butene; photochemistry of mercury–hydrocarbon matrices. (DHM)

29667 (FRNC-R-19, pp 193-197) COMPARATIVE STUDY OF THE PHOTOLYSIS AND RADIOLYSIS OF HYDROQUINONE IN THE PRESENCE OF OXYGEN. Fontenil, L.; Rocquet, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Comparative studies of radiolysis and photolysis phenomena are insufficient to give a detailed explanation of the action of oxygen on the radiolysis of hydroquinone. Nevertheless, such studies enable various mechanisms to be envisaged, the existence of which could be confirmed or rejected using complementary studies involving photolysis, phosphorescence or luminescence coupled with analytical techniques such as infrared, nuclear magnetic resonance, and chromatography. The hypothesis accepted implies parallel schemes for the action of $^1O_2$ on hydroquinone and for the action of $(O_2)^3\Sigma g$ on hydroquinone excited by ultraviolet radiation. Phosphorescence measurements on hydroquinone should enable the role of triplet states in this substance to be studied during its photosynthesis. (FR)

29668 (FRNC-R-19, pp 198-201) OXIDATION SENSITIZING DURING THE RADIOLYSIS OF BIOLOGICAL MEDIA. Champel,

P.; Rocquet, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The importance of the excitation energy in the development of damage due to irradiation has long been suspected. The excitation energy is a parameter almost as important as the ionization energy as far as damage phenomena are concerned. This excitation energy plays an important role in the oxygen effect. Much research has been made into the phenomenon of the energy transfer to oxygen or molecules of the substrate. Test molecules were exposed to UV irradiation and to γ irradiation in the presence of photosensitizing molecules. Hydroquinone was chosen as the substrate molecule and riboflavine as the sensitizing molecule. The results demonstrate that the presence of flavine favors the formation of oxidation products. Few results are yet available and their interpretation is delicate. (FR)

29669 (RISO-282) KINETIC STUDY OF THE EMULSION POLYMERIZATION OF VINYL ACETATE. Friis, N. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jun 1973. 120p. Dep. NTIS (U. S. Sales Only) $8.00.

Thesis. Submitted to Tekniske Hoejskole Lyngby (Denmark).

The chemically and the γ radio induced emulsion polymerization of vinyl acetate is reported. In experiments with potassium persulphate as initiator and sodium lauryl sulphate (SLS) as emulsifier the rate of polymerization is approximately proportional to the square root of initiator concentration and to the 0.25 power of the number of particles. The number of particles is proportional to the 0.5 power of the emulsifier concentration. The rate of polymerization is constant in the interval 15 to 70 to 85% conversion. (auth)

29670 (RISO-M-1643) ON-LINE PULSE RADIOLYSIS DATA HANDLING PROGRAM. Soee Hoejberg, K.; Pagsberg, P.; Hansen, K. B.; Jakobsen, G. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

A program is described for PDP8/E, 4k for the initial handling and presentation of pulse radiolysis data. The data are displayed on an oscilloscope or printed on a Teletype typewriter. A variety of algarithms for different kinetic types is available. A data reduction is obtained as only the accepted data are read out by means of the Teletype punch for further data handling. (DE)

29671 RADIOLYSIS OF AZO COMPOUNDS. Janovsky, I. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 15: No. 2, 73-76(25 Sep 1973).

Azo compounds carrying aromatic rings on both sides of the azo group are very stable. Radiolytic decomposition yielding nitrogen occurs in the case of compounds having aliphatic substituents bonded to the azo group. (auth)

29672 STUDY OF THE RADIOLYSIS OF EPICHLORHYDRIN BY AN ELECTRICAL CONDUCTIVITY METHOD. Zhikharev, V. S.; Zemskii, B. P.; Meleshevich, A. P. (Inst. of Physical Chemistry, Kiev). Zh. Obshch. Khim.; 43: No. 6, 1377-1381 (Jun 1973). (In Russian).

Purified epichlorhydrin was irradiated with ^{60}Co γ rays at dose rate of 200 to 2200 rads/sec. It is shown that the change in electrical conductivity of epichlorhydrin is a linear function of the adsorbed dose on taking the viscosity of the system into account. Hydrochloric acid is formed as a byproduct of the radiolysis of epichlorhydrin. The radiation-chemical yield of acid products is 0.8 molecule/100 eV up to a dose of 5×10^6 rads, and 0.2 molecules/100 eV at higher doses. The HCl reacts with the epichlorhydrin during the irradiation. This reaction continues after irradiation is stopped. (SJR)

29673 PULSE RADIOLYSIS OF TITANIUM(III) AND OTHER METAL(III) IONS IN THE PRESENCE OF FORMIC ACID. Ellis, J. D. (Univ. of Leeds, Eng.); Green, M.; Sykes, A. G.; Buxton, G. V.; Sellers, R. M. J. Chem. Soc., Dalton Trans.; No. 16, 1724-1728(1973).

Oxidation of titanium(III) to titanium(IV) by hydroxyl radicals is observed on pulse radiolysis of titanium(III) solutions at pH 1.4 in the absence of formic acid. In the presence of 1.0 M formic acid the formate radical CO_2H ($pK_a = 1.4$) is produced first, and titanium(III) is subsequently reduced to titanium(II), k = ca. 5×10^6 l mole^{-1} s^{-1} at room temperature, pH 1.4. Under the same conditions this radical also reduces europium(III), but not ytterbium(III), chromium(III), or scandium(III). Reduction of scandium(III) is not observed at pH 4.2 to 4.9 in the absence of formic acid. (auth)

29674 FORMATION AND PHOTOTRANSFORMATIONS OF PROTONATED ANION-RADICALS OF MONOCARBOXYLIC ACIDS. Chervonenko, V. S.; Roginskii, V. A.; Pshezhetskii, S. Ya. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 154-155(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 176-178(1973).

An ESR spectral study of radicals from the γ radiolysis at 77°K of monocarboxylic acids of the type RCH_2COOH (R = H, CH_3, C_2H_5, n-C_3H_7) is reported. It was concluded that both theoretical and experimental results indicate that anion radicals of RCH_2COOH are stabilized in a protonated form. (DHM)

29675 KINETICS OF THE ACCUMULATION OF RADIATION DEFECTS IN ANHYDROUS BERYLLIUM SULFATE AND ITS CRYSTALLINE HYDRATES. Karaseva, L. G.; Gromov, V. V.; Stepovaya, L. I. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 152-153(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 175-176(1973).

The concentration of paramagnetic centers (PMCs) was determined for the γ radiolysis of anhydrous beryllium sulfate and the crystalline tetrahydrate and dihydrate. At room temperature in all three salts the SO_3^- ion radicals are almost the only product stabilized. Consequently, G(PMC) calculated under these conditions practically corresponds to $G(SO_3^-)$ in the samples studied. At –196°C as well as at room temperature the tendency for the yield of PMC to decrease with an increase in the amount of water of crystallization was observed. It was concluded that with an increase in the amount of water of crystallization in the hydrated crystals the radiation yields of the main radiolysis products of the sulfate ions decrease, i.e., the water of crystallization has some "protective" action with respect to the crystal matrix. The products of the radiolysis of water that are formed are apparently inert with respect to the main substance and do not initiate any chemical processes whatever, as is observed in nitrates and nitrites. (DHM)

29676 RADIOLYSIS OF CYCLOHEXANE AND HEXANE IN THE PRESENCE OF IODINE. Zaitsev, V. M.; Serova, V. A.; Tikhonov, V. I. (Leningrad Inst. of Nuclear Physics). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 150-151(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 174-175(1973).

Yields are reported for the iodine-containing products formed by the γ radiolysis of cyclohexane and hexane containing 10^{-2} M iodide tagged with ^{125}I. The analysis showed that the total yield of organic compounds containing ^{125}I, G(RI), for the dose range 5.5×10^{18} to 6.6×10^{19} eV/g retains a constant value and is equal to 5.7 ± 0.4 and 4.2 ± 0.3 molecules/100 eV for cyclohexane and hexane respectively. The data obtained of the yields of the fragmentary products confirm the known fact of the high radiation stability of the cyclohexane ring in a condensed medium. The overall yield of all of the iodine-containing products, which are formed during the opening of the ring, is 0.246; the main product is 1-iodohexane with $G(1\text{-}C_6H_{13}I) = 0.20$ which is formed for the rupture of only one C – C bond. The other products are mainly iodoalkanes with from 1 to 4 carbon atoms. Of the unsaturated compounds only vinyl iodide was observed. (DHM)

29677 EFFECT OF THE CHEMICAL NATURE OF LIGANDS ON THE REACTION RATE FOR HYDROGEN ATOMS WITH SOME COMPLEX COMPOUNDS OF Co(III). Shagisultanova, G. A.; Tikhonov, A. S.; Sokolova, L. A. (Belorussian State Univ., Minsk). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 148-149(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 172-173(1973).

Values of the rate constants for the reactions of H atoms with compounds of the type $[Co(NH_3)_4X_2]^+$ are given. The aim of the experiments was to establish the effect of the chemical nature of the amine and aniono ligands and also of the spatial structure of the complexes on the rate of their reactions with atoms of hydrogen. (DHM)

29678 ELECTRON STAGES IN THE RADIOLYSIS OF SOLID INORGANIC SALTS. Zakharov, Yu. A.; Vasil'ev, A. A.; Ryabykh, S. M.; Nevestruev, V. A.; Safonov, Yu. N.; Serikov, L. V. (Tomsk Polytechnic Inst., USSR). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 143-147(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 166-171(1973).

Radiolysis stages, occurring with the participation of free electrons in solids, were studied in alkali metal chlorates and perchlorates and in silver and lead azides. The yield of primary radicals and electrons was found in all cases to be equal to the total yield of salt radiolysis. Products of the electron stages of radiolysis are metals (in azides) and electron color centers (in chlorates and perchlorates); ClO_3^{2-} ions are also formed in perchlorates. A series of kinetic parameters was determined for the radiolysis of potassium perchlorate. The use of these parameters in an analogous model of the radiolysis of $KClO_4$ showed a satisfactory agreement between the assumed mechanism and the real process of radiolysis. (auth)

29679 KINETICS OF THE CONVERSION OF SILVER ATOMS IN FROZEN AQUEOUS SOLUTIONS OF SILVER NITRATE. Popovich, G. M.; Golubev, V. B.; Bugaenko, L. T. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 138-142(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 159-165(1973).

The kinetics of thermal conversions of silver atoms stabilized in γ-irradiated frozen aqueous solutions of silver nitrate are investigated. At the beginning of the warming up of the irradiated samples, there is observed an increase in the number of atomic silver centers of all types, corresponding to their different stabilization sites in the solid matrix, and then they are destroyed. The increase in the number of silver atoms at low temperatures and the stepwise character of the kinetic curves for the destruction of the silver atoms at higher temperatures are explained by the additional formation of silver atoms due to the reaction of silver ions with electrons stabilized in the traps and liberated on heating. A kinetic scheme is proposed which satisfactorily describes the increase in the concentration of atoms at low temperatures and the stepwise character of their destruction at higher temperatures. (auth)

29680 END PRODUCTS OF PULSE RADIOLYSIS AND RADIATION OXIDATION OF N-HEPTANE AT HIGH DOSE INTENSITIES WITH AND WITHOUT ACCEPTORS. Zimina, G. M.; Pichuzhkin, V. I.; Chubakova, T. A.; Bakh, N. A. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 134-137(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 154-158(1973).

The composition and structure of the products of pulse radiolysis and radiation-oxidation of n-heptane were investigated. It is shown that an increase by seven orders in the dose intensity has no effect on the total yield of heptyl radicals, but does affect their structure, resulting approximately in a free radical distribution corresponding to a statistical distribution of free valencies on the carbon atoms. Yields of the end products of radiation-oxidation of n-heptane in presence of molecular oxygen were determined and were found to be the same as the values obtained at low dose intensities. It was concluded that there is oxygen capture of radicals that evade recombination in the tracks and undergo transformation. The effect of nitrous oxide on the end products of radiation-oxidation supports the assumption that the precursors of alcohols, carbonyl compounds, and peroxides are of different types. (auth)

29681 RADIATION-CHEMICAL SYNTHESIS OF DIALKYLTIN DIBROMIDES. IV. Macrokinetic Laws of the Synthesis of R_2SnBr_2 ($R = C_3H_7 - C_5H_{11}$). Miretskii, V. Yu.; Vereshchinskii, I. V. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 129-133(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 149-153(1973).

A study is presented of the macrokinetic laws of the formation of R_2SnBr_2 under the action of ^{60}Co γ radiation under the conditions of bench apparatus that are common to the homologous series. A number of R_2SnBr_2 compounds were synthesized, and the constants of these compounds and the values of the corresponding radiation-chemical yields are reported. The effect on the formation of R_2SnBr_2 of the ratio of the reactants, the temperature, and the absorbed dose rate was established. The effective activation energy of the formation of R_2SnBr_2 was determined; in the temperature range 70 to 115°C it is about 12 kcal/mole. Information is given on the relative rates of formation of R_2SnBr_2 as a function of the size of the alkyl radical and of the yields of R_2SnBr_2 with respect to tin and to alkyl bromide. (auth)

29682 NATURE OF THE RADICAL PAIRS IN γ-IRRADIATED ADDUCTS OF DIANIN'S COMPOUND. Kuleshov, A. P.; Trofimov, V. I. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 124-128(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 143-148(1973).

ESR techniques were used to investigate the paramagnetic centers in adducts of 2,2,4-trimethyl-4-oxyphenyl-2,3-dihydrobenzopyran (Dianin's compound (DC)) with a number of organic compounds, irradiated with γ rays at 77°K. It was found that, on irradiation of crystalline DC and its adducts with diethyl ether, methyl and ethyl alcohols, 1,3-dioxolane, benzene, benzene-d_6, aniline, pyridine, acetophenone, and nitrobenzene, radical pairs of two types are formed from the matrix molecules, the axes of the pairs of each type having three possible orientations in the elementary cell of the adduct crystal. Structures are proposed for these radical pairs. The interpretation is supported by calculations using x-ray crystallographic data taken from the literature on the crystal lattice of DC adducts. (auth)

29683 KINETICS OF RADIOTHERMOLUMINESCENCE FOR AN ARBITRARY SPATIAL DISTRIBUTION OF CHARGES. Novikov, G. F.; Ametov, K. K.; Yakovlev, B. S. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 118-123(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 136-142(1973).

A study was carried out of the kinetics of radiothermoluminescence (RTL), arising from the recombination of electrons thermally released from traps and positive ions produced in the substance by ionizing radiation. Assuming traps of a single type, the time dependence of the RTL was calculated for an arbitrary initial distribution of ions and electrons. The calculated results are compared with experimental data from an experimental investigation of the RTL from polybutadiene, irradiated at 77°K. It was found that satisfactory agreement with experiment can be obtained by taking into account repetitive capture and a non-uniform spatial distribution of charges. (auth)

29684 OPTICAL ABSORPTION SPECTRA OF THE SOLVATED ELECTRON IN IRRADIATED MONOETHANOLAMINE. Marevtsev, V. S.; Vannikov, A. V. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 104-108(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 119-124(1973).

The optical absorption spectra of the solvated electron were investigated during the pulse irradiation of pure monoethanolamine, an equimolar mixture of ethanol and monobutylamine, and solutions of $CaCl_2$ in monoethanolamine. The locations of the optical absorption maximums of e_s^- in the mixture and in pure monoethanolamine are close to each other although the static dielectric constants of these liquids differ considerably. This fact permits one to presume that the dielectric constant does not play a major role in the position of the absorption maximum. Additions of $CaCl_2$ to monoethanolamine increase the yield of e_s^-, which is explained by the neutralization by Cl^- anions which takes place in the wake of the positive ions. (auth)

29685 ANTHRACENE FLUORESCENCE UPON EXCITATION WITH SLOW ELECTRONS. Danil'chenko, E. Ya.; Frankevich, E. L. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 99-103(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 113-118(1973).

The kinetics of disappearance and the spatial distribution of triplet excitons in the track of ionizing particles were investigated by the study of forms of fluorescence impulses, excited with slow-electron impulses having an energy of 2 to 8 keV of duration 2 to 8 μsec, in anthracene monocrystals. Calculations were made of the track cross section: $\sigma = 4.3 \cdot 10^{-11}$ cm^2 (±20%). It was shown that upon using slow electrons for excitation of fluorescence of anthracene at times $t \gtrsim 10^{-6}$ sec the "specified-diffusion" model cannot be used to describe the time of evolution of the track. An evaluation was made of the ratio of radiation yields of triplet and singlet excitons: $G_T/G_S = 2.8 \pm 0.2$. (auth)

29686 SOME FEATURES OF THE ACCUMULATION OF FREE RADICALS ON SIMULTANEOUS IRRADIATION WITH IONIZING RADIATION AND WITH LIGHT. Zhdanov, G. S.; Milinchuk, V. K.; Pshezhetskii, S. Ya. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 172-173(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 190-191(1973).

A consideration of the kinetics of the accumulation of radicals under the action of γ-radiation and light has shown that for the case of feebly-absorbing media and thin layers on simultaneous irradiation the concentration of radicals reaches a constant value $[R]_{rel}^{\infty} = (kI/k_1 j)^{0.5}$, where k and k_1 are the rate constants of the formation and photorecombination of the radicals, respectively, and I and j are the intensities of the γ radiation and the light. On successive irradiation, the maximum concentration of radicals is given by the relation $[R]_{suc}^{max} = 0.5\,[R]_{rel}^{\infty}$. On periodic irradiation, the concentration of radicals assumes intermediate values between the values of the concentration of the radicals on simultaneous and successive irradiation with ionizing radiation and with light. The kinetic curves obtained are in satisfactory agreement with the experimental curves of the accumulation of peroxy radicals in polypropylene at 300°K. The difference in the amounts of radicals accumulating on simultaneous, successive, and periodic irradiation is that on simultaneous irradiation smaller concentrations of radicals are subjected to the action of light than in successive and periodic irradiations. (DHM)

29687 INVESTIGATION OF THE FREE RADICALS IN γ-IRRADIATED POLYMERS BY THE ELECTRON SPIN ECHO METHOD. Klinshpont, E. R.; Gilyazitdinov, D. G.; Kiryukhin, V. P.; Milinchuk, V. K. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 170-171(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 188-189(1973).

The principles governing the decay of the electron spin echo (ESE) signals and the ESE spectra of a series of free radicals possessing various mechanisms for the nonhomogeneous broadening of the ESR lines were investigated. The free radicals in γ-irradiated deuterated polypropylene and poly(ethylene-glycol) were investigated. The alkyl radicals in polypropylene, the ESR spectrum of which consists of four hyperfine structural lines, and the peroxide radicals in polypropylene, the ESR spectrum of which was broadened through the anisotropy of the g-factor, were also studied. The decays in the ESE in relation to τ (μsec) in the

initial interval ($0.4 < \tau < 1$) are satisfactorily depicted by the exponential relationship $V = V_0 \exp(-2b\tau)$, where b is the reciprocal decay time of the ESE signal. The measurements at 4.2 and 77°K showed that b depends slightly on temperature. This indicates that spin-lattice interaction makes a small contribution to the relaxation processes. (DHM)

29688 FREE RADICAL DISTRIBUTION BETWEEN PHASES IN RADICAL INITIATED PROCESSES IN EMULSIONS. Lukhovitskii, V. I.; Polikarpov, V. V.; Lebedeva, A. M.; Karpov, V. L. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 168-169(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 187-188(1973).

In examining chain free-radical processes in emulsion systems which are initiated by ionizing radiation, it is important to know the fate of the primary (low-molecular) free radicals which get into the latex particles and micelles from the aqueous phase. As follows from experimental data, and also from theoretical considerations, the probability of exit of a free radical from a latex particle is very small. Meanwhile, the time for addition of one monomeric unit to a free radical in the case of styrene, for example, is 10^{-3} sec, while the time needed for exit of a free radical from the particle, as calculated from the formula for mean-squared movement, is about 10^{-5} sec for a latex particle of 500 Å diameter, and is 10^{-9} sec for a micelle. Hence, the probability of exit of a free radical from a latex particle, α_L, or from a micelle, α_M, should be close to 1. To explain this discrepancy, the suggestion that an energy barrier ("workfunction") exists, which prevents the free radical from leaving the particle, is investigated. Experiments were performed using radical-emulsion polymerization of styrene. (DHM)

29689 INITIATION RATE AND CHAIN LENGTH IN THE OXIDATION OF ISOSAFROLE INITIATED BY γ-RADIATION. Komarov, P. N.; Baranova, N. M. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 166-167(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 185-187(1973).

The inhibiting effect of sulfuric acid on the oxidation of alkenylbenzene in solutions initiated by γ radiation was used to estimate the initiation rate and chain length in the oxidation of isosafrole in glacial acetic acid at 23°C. The rate of initiation obtained was 3.1×10^{-6} M/l sec. The chain length was found to be ~550 members. Judging from the effect of different additions on the oxidation of isosafrole in solutions and the value of G_x (yield of the chain-initiating particles) obtained, charged particles, which may be thermal electrons or anion radicals, are probably the active centers in this process. (DHM)

29690 ELECTRON SPIN RESONANCE DETECTION OF ACRYLIC ACID RADICAL ANIONS AND RELATED SPECIES IN LOW TEMPERATURE GLASSES. Metcalfe, E.; Symons, M. C. R.; Begum, A.; Charlesby, A. (Univ. of Leicester, Eng.). Mol. Phys.; 26: No. 2, 509-511(Aug 1973).

Exposure of pure acrylic acid and related acrylic monomers to high energy radiation at 77°K generally results in the formation of a radical apparently formed by hydrogen atom addition to the β-carbon. On annealing, these radicals add to neighboring monomers. Recently a 14 G triplet has been obtained from various polymer and acrylic acid systems after irradiation at 77°K, which was very tentatively assigned to the acrylic acid radical cation. For various acrylic monomers $R_2C = CR\,CO_2R$, hyperfine coupling was only obtained from the R_2C- moiety. Thus $H_2C =$ species gave a 12 to 14 G triplet, $MeCH =$ species gave a 12 G quintet, and $Me_2C =$ species gave a 12 G septet. A case for suggesting that the species responsible for these spectra are the radical anions rather than the cations is presented.

29691 ELECTRON SCAVENGING BY BROMOBENZENE IN THE RADIOLYSIS OF HYDROCARBON SOLUTIONS. Tanaka, M.; Fueki, K. (Nagoya Univ., Japan). J. Phys. Chem.; 77: No. 21, 2524-2527(11 Oct 1973).

A quantitative study was made of electron scavenging processes in γ-irradiated liquid hydrocarbons: n-pentane, cyclopentane, n-hexane, cyclohexane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane, 2,2,4-trimethylpentane, and n-octane. The benzene yield observed upon electron scavenging by bromobenzene in the hydrocarbon solutions can be quantitatively described by an empirical model developed by Schuler and coworkers. The ion-pair yields and the reactivity parameters for electron scavenging were obtained by the analysis of data. The results indicate that the total ion-pair yields in liquid alkanes are about 4 and do not differ very much from the gas-phase values. The ranges of electrons in the hydrocarbons studied were also calculated based on a model in which a simple exponential distribution was assumed for initial electron-positive ion separation distances. (auth)

29692 ELECTRON REACTIONS IN AQUEOUS CONCENTRATED ACID SOLUTIONS. Micic, O. I.; Markovic, V.; Nikolic, D. (Boris Kidric Inst. of Nuclear Science, Vinca, Yugoslavia). J. Phys. Chem.; 77: No. 21, 2527-2530(11 Oct 1973).

Competition between some organic compounds (glycine, acetic acid, propionic acid, and acetone) and the hydronium ion for hydrated electrons in γ-irradiated aqueous concentrated acid solution was studied. These compounds show an ability to reduce the initial yield of the hydrated electron without any direct correlation with the corresponding hydrated electron rate constants. The results are discussed taking into account the protonation effects, the time dependence of the rate constants, and the possibility of reaction with a hydrated electron precursor. They support the idea that radiation-produced electrons react before hydration. (auth)

29693 RADIOLYSIS OF PYRIMIDINES IN AQUEOUS SOLUTION. 1. Product Formation in the Interaction of e^-_{aq}, ·H, ·OH, and Cl_2^-· With Thymine. Infante, G. A.; Jirathana, P.; Fendler, J. H.; Fendler, E. J. (Texas A and M Univ., College Station). J. Chem. Soc., Faraday Trans., I; 69: No. 9, 1586-1596 (1973).

Product yields in the reaction of e^-_{aq}, ·H, ·OH and Cl_2^- · with thymine and those in the reaction of e^-_{aq} and ·OH/O^-· with thymine$^-$ were determined quantitatively in ^{60}Co γ-irradiated aqueous thymine solutions in the presence of suitable scavengers. Good material balances between G(-thymine) and G(total products) were obtained in all cases. The products determined were: thymine dimers, cis-thymine glycol, trans-thymine glycol, 5-hydroxydihydrothymine, 6-hydroxydihydrothymine, dihydrothymine, 5-hydroperoxydihydrothymine, 5-hydroxymethyluracil, 5-hydroxy-5-methylbarbituric acid, formyl-pyruvylurea, acetylurea, urea, and alcohol adducts. Based on the yields of these products and the available literature, mechanisms are proposed and discussed. (auth)

29694 CONFORMATIONAL CHANGES OF α-AMYLASE BY GAMMA IRRADIATION IN AQUEOUS SOLUTION. Tanabe, R. (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 51: No. 1, 44-58(Jan 1973).

The states of amino acid residues, tryptophan, tyrosine and histidine, in α-amylase were investigated using the reaction between the residues and specific chemical reagents, and the conformational degradation by irradiation was presumed from the alteration in the states of these residues or their circumstances. From the facts obtained, the irradiated and inactivated enzyme protein was found to have such a conformation as more acceptable of the effect of chemical reagent than that of intact one. In order to study the conformational changes of α-amylase by γ-ray irradiation in aqueous solution, spectrophotometric titration of tyrosyl residues, optical rotary dispersion, electrophoresis and optimum pH in enzyme reaction were investigated. These results indicated that the conformation of the enzyme was degradated and some of the tyrosyl residues embedded within a protein molecule were exposed by irradiation. The irradiated enzyme was more electronegative than the intact one and the isoelectric point of the enzyme protein was changed from pH 5.5 to pH 1.0 by the irradiation, but not changed was the optimum pH. (auth)

29695 SOME SIMPLE, HIGHLY REACTIVE, INORGANIC CHLORINE DERIVATIVES IN AQUEOUS SOLUTION. Their Formation Using Pulses of Radiation and Their Role in the Mechanism of the Fricke Dosimeter. Jayson, G. G.; Parsons, B. J.; Swallow, A. J. (Liverpool Polytechnic). J. Chem. Soc., Faraday Trans., I; 69: No. 9, 1597-1607(1973).

In aqueous solution OH radicals react with chloride ions to form initially $ClOH^-$ the rate constant being $4.3 \pm 0.4 \times 10^9$ l mol^{-1} s^{-1}. The rate constant for the dissociation of $ClOH^-$ back to OH radicals and chloride ions is $6.1 \pm 0.8 \times 10^8$ s^{-1}. $ClOH^-$ is converted to chlorine atoms via the reaction, $ClOH^- + H^+$ $Cl + H_2O$ ($k = 2.1 \pm 0.7 \times 10^{10}$ l mol^{-1} s^{-1} at an ionic strength of unity), the rate constant for the reverse reaction being 1.3×10^3 l mol^{-1} s^{-1} (0.3 to 3.0×10^3 l mol^{-1} s^{-1}). Chlorine atoms combine with chloride ions to form Cl_2^- ($k = 2.1 \times 10^{10}$ l mol^{-1} s^{-1}), the rate constant for the dissociation of Cl_2^- back to chlorine atoms and chloride ions being $1.1 \pm 0.4 \times 10^5$ s^{-1}. The absorption spectra of $ClOH^-$ and Cl_2^- were measured in the range 230 to 450 nm. Cl_2^- absorption has a maximum at 340 nm where the extinction coefficient is $8.8 \pm 0.5 \times 10^3$ l mol^{-1} cm^{-1}, whereas $ClOH^-$ has a maximum at 350 nm with an extinction coefficient of $3.7 \pm 0.4 \times 10^3$ l mol^{-1} cm^{-1}. The reactions of chlorine atoms and Cl_2^- with ferrous ions were also investigated and the constants are $5.9 \pm 0.6 \times 10^9$ and $1.4 \pm 0.2 \times 10^7$ l mol^{-1} s^{-1} (ionic strength = 0.1 mol l^{-1} respectively. The effect of chloride ions on the mechanism of the Fricke dosimeter is discussed. (auth)

29696 AB INITO HARTREE-FOCK CALCULATIONS WITH INCLUSION OF A POLARIZED DIELECTRIC; FORMALISM AND APPLICATION TO THE GROUND STATE HYDRATED ELECTRON.

Newton, M. D. (Brookhaven National Lab., Upton, NY). J. Chem. Phys.; 58: No. 12, 5833-5835(15 Jun 1973).

An extension of the usual ab initio molecular orbital formalism is presented that makes accessible a large and important intermediate category-that of a discrete molecular aggregate imbedded in a continuum. The case of localized charge and its first shell, surrounded by a continuous polarized dielectric, is studied. The formalism presented is used to calculate some important ground state properties of the hydrated electron, and the crucial role of solvation beyond the first shell is demonstrated. (DHM)

29697 MECHANISM OF OXIDATIVE DENITRATION OF 5-NITROURACIL AND 5-NITRO-2-FUROIC ACID BY HYDROXYL RADICALS. Zemel, H.; Neta, P. (Carnegie-Mellon Univ., Pittsburgh). Radiat. Res.; 55: No. 3, 393-398(Sep 1973).

The reactions of hydroxyl radicals with 5-nitrouracil, 5-nitrobarbituric acid, and 6-nitro-2-furoic acid in aqueous solutions were studied by conductometric pulse radiolysis and by determination of the yield of nitrate in irradiated solutions. Addition of OH to the position bearing the nitro group was found to be followed by immediate elimination of HNO_2. This path accounts for 25% of the OH reaction with 5-nitrouracil and 75% with 5-nitro-2-furoic acid. An additional yield of nitrite is, however, produced on the time scale of the decay of the organic radicals and the total yield reaches 85% of G(OH) for both the nitrouracil and the nitrofuroic acid. This slower formation of nitrite is a result of radical disproportionation by electron transfer. This mechanism was found to be pH dependent with the yield for nitrite formation decreasing in acid solutions. (auth)

29698 PULSE RADIOLYSIS STUDY OF THE CHEMILUMINESCENCE FROM LUMINOL. (5-Amino-2,3-Dihydrophthalazine-1,4 Dione). Baxendale, J. H. (Univ. of Manchester, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 9, 1665-1677(1973).

Chemiluminescence is observed when alkaline solutions of luminol containing oxygen are subjected to pulses of 10-MeV electrons. It is shown that the first reaction in a series, which leads finally to luminescence, is that between luminol and the radical OH having $k = 8.7 \times 10^9$ l. mol^{-1} s^{-1}. The product of this reaction reacts with oxygen ($k = 1.0 \times 10^9$ l. mol^{-1} s^{-1}) to give a species that undergoes a first order change (k ca. 10^5 s^{-1}) to the intermediate directly responsible for the luminescence. The kinetics of the luminescence are consistent with the conclusion that the emitting species is produced in the biomolecular reaction of this intermediate with itself ($k = 3.8 \times 10^8$ l. mol^{-1} s^{-1}). A reaction scheme is proposed, which suggests that the aminophthalate excited state that gives rise to the luminescence is produced by the mutual reaction of peroxy free radicals in this last step of the sequence. (auth)

29699 G-VALUES OF NITROGEN OBTAINED FROM THE GAS-PHASE GAMMA RADIOLYSIS OF NITROUS OXIDE-HYDROCARBON SYSTEMS. Okazaki, K.; Yugeta, R.; Sato, S. (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 46: No. 7, 2066-2070 (Jul 1973).

The gas-phase γ-radiolysis of a N_2O-1-butene system was reinvestigated. The other hydrocarbons used for the substrate are ethylene, propylene, 1,3-butadiene, cyclopropane, propane, and n-butane. The G-value of nitrogen from any system increased with an increase in the pressure of N_2O and was saturated at about 4 mol% of N_2O. The saturated value, $G(N_2)_{max}$, was much larger than the G-value of electrons estimated from the W-value of the hydrocarbon used and was rather strongly dependent upon the irradiation temperature, the dose rate, and the total dose. Some of the results were not consistent with those reported by the previous investigators. The reason for this discrepancy, and also the possible reaction mechanism to explain the large $G(N_2)_{max}$, are discussed. (auth)

29700 PULSE-RADIOLYSIS STUDY OF A BIOLOGICAL MATRIX. Cercek, B.; Cercek, L. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 24: No. 2, 137-142(Aug 1973).

The technique of pulse radiolysis was used to study radiolytic processes in egg-white. The yield of e^-_{aq} is 74.5% of that in pure water. The half-life for the decay of e^-_{aq} is 4.5×10^{-6} sec and that for the decay of OH radicals is $< 5 \times 10^{-9}$ sec. Cystine anion-radicals are produced with a yield of $G(Cy^{\tau}) = 1.44$. Part of the cystine anion-radical decays via a reaction with oxygen ($k(Cy^{\tau} + O_2) = 1.3 \times 10^8 M^{-1} sec^{-1}$). (auth)

29701 REACTIONS BETWEEN NITROXYL FREE RADICALS AND RADIATION-INDUCED TRANSIENTS IN NUCLEOSIDES. Wold, E.; Brustad, T. (Norsk Hydros Institutt for Kreftforskning, Oslo). Int. J. Radiat. Biol.; 24: No. 2, 153-160(Aug 1973).

Second-order rate constants were determined by pulse radiolysis for reactions of the three organic nitroxyl compounds TAN, TMPN, and NPPN with OH-induced transients in four nucleosides at pH 7. The results are presented and compared with the rate constants for the reactions with the corresponding DNA-bases. (auth)

29702 ENERGY TRANSFER IN THE RADIOLYSIS OF A NEOPENTANE ALKANE MIXTURE IN THE SOLID PHASE AT 77°K. Kato, M.; Saitake, Y.; Miyazaki, T.; Kuri, Z. (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 46: No. 7, 2004-2007(Jul 1973).

When neopentane containing a small amount of cyclohexane is γ-irradiated at 77°K, the cyclohexyl radical is mainly formed by the energy transfer from neopentane to cyclohexane. The addition of CCl_4, which is an electron scavenger and an excitation acceptor, to the mixture suppresses the formation of the cyclohexyl radical. This fact indicates that the energy transfer is not due to an ion–molecule reaction. When CO_2, which can capture an electron in the neopentane matrix to form CO_2^-, is added to the neopentane–cyclohexane mixture, scarcely any CO_2^-, is formed by the irradiation. When ethyl chloride or nitrous oxide is added to the neopentane–cyclohexane mixture, the formation of the cyclohexyl radical is not suppressed, although these additives capture electrons effectively in solid neopentane. The addition of tetramethylethylene (TME) to the neopentane–cyclohexane–carbon dioxide mixture does not affect the formation of the cyclohexyl radical, although an appreciable amount of TME+ is formed. These results show that the energy transfer is not due to the ionic process, but to a non-ionic process. The energy transfer is explained by two possible mechanisms, a selective abstraction reaction by the hydrogen atom and an excitation transfer via a highly-excited state. (auth)

29703 ADDITION OF HYDROGEN ATOMS TO SUBSTITUTED BENZENES. Use of the Hammett Equation for Correlating Radical Reactions. Pryor, W. A.; Lin, T. H.; Stanley, J. P.; Henderson, R. W. (Louisiana State Univ., Baton Rouge). J. Amer. Chem. Soc.; 95: No. 21, 6993-6998(17 Oct 1973).

Isomer distribution data are reported for the addition of tritium atoms, generated by photolysis of thiophenol-t, to monosubstituted benzenes at 40°C. These data are combined with literature values of the total rate constant for the addition of H atoms to substituted benzenes, and relative rate constants are calculated for the rate of addition to the ortho, meta, and para positions (so called partial rate factors). A Hammett correlation of the meta and para partial rate factors gives a ρ of -0.24 ± 0.09; a correlation of meta data only gives a ρ of -0.28 ± 0.12. These ρ values are compared with values derived from studies of H atoms generated by aqueous radiolysis. A compilation is given of Hammett ρ values for the abstraction of hydrogen from the benzylic position of toluenes by various free radicals and the addition of radicals to monosubstituted benzenes. Unexpectedly, the ρ values for the two reactions are quite similar for the five of the six radicals for which both ρ values are known; it is suggested that this similarity may be general. The use of the Hammett equation to correlate radical reactions is discussed. (auth)

29704 KINETICS OF COMPETING FREE RADICAL REACTIONS WITH NITROAROMATIC COMPOUNDS. Greenstock, C. L.; Dunlop, I. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). J. Amer. Chem. Soc.; 95: No. 21, 6917-6919(17 Oct 1973).

Rate constants for the competing reactions between alcohol donor free radicals and nitroaromatic compounds, and their relative efficiencies, were measured by pulse radiolysis. The kinetics of formation of the nitroaromatic anion species are dependent upon the sum of the rate constants for both competing reactions and not upon the rate constant for radical oxidation alone. The rate constants for donor radical oxidation and adduct formation increase with increasing redox potential of the electron acceptor. Although α- and β-hydroxy radicals have similar reactivities, α-hydroxy radicals are oxidized preferentially whereas β-hydroxy radicals predominantly form adducts. (auth)

29705 ELECTRON SPIN RESONANCE SPECTRA OF RADICALS RELATED TO THE INTERMEDIATES IN THE OXIDATION OF ASCORBIC ACID. The Radical Produced from γ-Methyl-α Hydroxytetronic Acid. Kirino, Y.; Schuler, R. H. (Carnegie-Mellon Univ., Pittsburgh). J. Amer. Chem. Soc.; 95: No. 21, 6926-6928(17 Oct 1973).

The radical intermediate produced in the oxidation of aqueous solutions of γ-methyl-α-hydroxytetronic acid by OH radicals was examined by the in situ radiolysis-ESR method. The g factor (2.00519) and proton hyperfine constants ($a^H(H_4) = 1.84$ G and $a^H(CH_3) = 0.05$ G) for the radical produced in neutral and basic solutions are very similar to those for the radical produced in the chemical and radiation chemical oxidation of ascorbic acid. Spectra of four of the five ^{13}C-containing radicals were observed at the natural abundance level ($a^C = 5.69$, 3.54, 2.76, and 0.91 G). It is clear that above pH 1 the radical exists as an anion with the unpaired electron delocalized in a highly conjugated tricarbonyl

system. From the dependences of the g factor and the proton hyperfine constant on pH, the pK for the protonation of the radical anion was determined to be −0.40. (auth)

29706 REACTIONS OF HYDROXYL RADICALS WITH UNSATURATED ALIPHATIC ALCOHOLS IN AQUEOUS SOLUTION. A Spectroscopic and Electron Spin Resonance Radiolysis Study. Simic, M. (Univ. of Texas, Austin); Neta, P.; Hayon, E. J. Phys. Chem.; 77: No. 22, 2662-2667(25 Oct 1973).

The reactions of OH and O^- radicals with allyl alcohol, 1,4-pentadien-3-ol, and 2,4-hexadien-1-ol in aqueous solutions were studied using the spectrophotometric pulse radiolysis and the in situ steady-state radiolysis-ESR techniques. The reaction rate constants of the OH radicals with these compounds ranged from 6.0 to 10.0×10^9 M^{-1} sec^{-1} and of O^- radicals from 2.4 to 4.3×10^9 M^{-1} sec^{-1}. The transient absorption, extinction coefficients, and decay kinetics of the intermediates produced from the reactions of OH, O^-, and H atoms with these alcohols were determined. The OH radicals were found to add predominately to the carbon−carbon double bonds, but a measurable proportion (10 to 20%) were found to abstract hydrogen from allylic positions (α-hydroxy positions). With conjugated double bonds, e.g., 1.4-pentadien-3-ol, the extent of abstraction by OH radicals increased by a factor of 2. The O^- radicals were found to react predominately by hydrogen atom abstraction. The presence of double bonds conjugated to the α-hydroxy radical site was found to considerably increase the acidity of these radicals. Thus, the pK_a of the $CH_2 = CH\dot{C}HOH$ and $CH_2 = C\dot{H}C(OH)CH = CH_2$ radicals are 9.6 ± 0.1 and 8.9 ± 0.1, respectively. The ESR experiments confirm the abstraction reactions of O^- radicals with these compounds. The importance of the abstraction reactions of OH radicals from substituents in an α position to double bonds are discussed. These reactions may be of importance in the fields of radiation polymerization and biological radiation damage. (auth)

29707 PREHYDRATION SCAVENGING OF e^-_{aq} AND THE YIELDS OF PRIMARY REDUCING PRODUCTS IN WATER γ-RADIOLYSIS. Draganic, Z. D.; Draganic, I. G. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Phys. Chem.; 77: No. 22, 2691-2693(25 Oct 1973).

The formation of primary reducing yields of water radiolysis was examined in neutral aqueous solutions of alanine and glycine. Increase in concentration of the amino acids was found to lead to decrease in $G(e^-_{aq})$, $G(H)$, and $G(H_2)$. Low reactivities toward e^-_{aq} in the solutions studied suggest that the prehydration scavenging of e^-_{aq} is the cause of decrease in $G(e^-_{aq})$ and therefore in $G(H)$ and $GH_2)$. The consequences of prehydration scavenging for the water decomposition yield are considered. (auth)

29708 STUDY OF THE FORMATION OF NEGATIVE IONS IN NITRIC OXIDE AND THE INTERACTION OF NO WITH H^- AND O^- FROM WATER. Gupta, S. K.; Melton, C. E. (Univ. of Georgia, Athens). J. Phys. Chem.; 77: No. 22, 2594-2598(25 Oct 1973).

A comprehensive study on the formation of negative ions in nitric oxide, primary as well as secondary was made. Three ions, O^-, NO^-, and NO_2^-, were observed. The appearance potential of O^- is 7.0 eV. A maximum cross section of 1.2×10^{-18} cm^2 $molecule^{-1}$ was observed at 8.0 eV. The ions NO^- and NO_2^- are produced by termolecular reactions of the type $(NO)_2 + e \rightarrow NO^- + NO$ and $O^- + (NO)_2 \rightarrow NO_2^- + NO$. An unusually large rate constant of 7.6×10^{-27} cc^3 sec^{-1} was observed for the termolecular reaction producing NO_2^-. Mixtures of NO and H_2O were studied to determine the mechanism of the action of NO in radiolysis reactions. In addition to the O^-−NO reaction, a charge transfer reaction $H^- + NO \rightarrow H + NO^-$ was observed with a rate constant of $k = 4.0 \times 10^{-9}$ cc $molecule^{-1}$ sec^{-1}. The experimental value of the rate constant is in excellent agreement with the theoretical value derived on the assumption of locked-dipole ion−molecule interactions. It is shown that the scavenger NO is actually a source of H atoms produced by the reaction of NO with H^-. (auth)

29709 KINETICS OF ELECTRON TRANSFER FROM AROMATIC RADICAL ANIONS TO ALKYL HALIDES IN TETRAHYDROFURAN. Effects of Sodium Cation Pairing. Bockrath, B.; Dorfman, L. M. (Ohio State Univ., Columbus). J. Phys. Chem.; 77: No. 22, 2618-2622(25 Oct 1973).

Absolute rate constants were determined, by the pulse radiolysis method, for electron transfer from naphthalenide and biphenylide ions to n-butyl iodide in tetrahydrofuran solution. The sodium cation-paired form of the radical anion, (Na^+, A^-), exhibits reactivity that is roughly two orders of magnitude lower than that of the free radical anion, A^-. The temperature coefficient for the reaction was interpreted in terms of an equilibrium of loose and tight ion pairs, the former exhibiting greater reactivity. A small effect of added salts upon the rate constants was observed. (auth)

29710 ELECTRON PARAMAGNETIC RESONANCE STUDY OF HYDROGEN ATOMS TRAPPED IN γ-IRRADIATED LITHIUM PHOSPHATES. Vermani, Y. P.; Zimbrick, J. D.; Zeller, E. J. (Univ. of Kansas, Lawrence). J. Phys. Chem.; 77: No. 22, 2622-2628.

EPR studies were carried out on trapped H atoms (H) in ^{60}Co γ-irradiated lithium ortho-, meta-, and pyrophosphate polycrystals at room temperature. The radiation yields of H_t varied from $G(H_t) = 0.08$ for lithium orthophosphate to $G(H_t) = 0.01$ for lithium meta- and pyrophosphate. The H_t decayed slowly at room temperature with initial halftimes that varied from 14 hr for lithium orthophosphate to 48 hr for lithium pyrophosphate. The widths of the EPR lines of H_t varied from 0.74 G for lithium orthophosphate to 3.2 G for lithium metaphosphate. Two sets of satellite lines were observed in the EPR spectra of the H_t doublet in lithium orthophosphate and lithium pyrophosphate. These satellites were attributed to forbidden spin flips of adjacent H and P nuclei which populate the H atom traps. Paramagnetic relaxation time measurements vs. radiation dose were made on the H_t EPR lines in lines in lithium orthophosphate. These data when correlated with thermal decay and dose saturation data supported the hypothesis that the H_t are distributed uniformly in the polycrystalline matrix. (auth)

29711 R-INDUCED AND THERMAL REACTIONS OF ALLYL ACETATE WITH AMINES. Oka, K.; Ogawa, K.; Fukumoto, T.; Tsurugi, J. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 111-112(1972).

γ-Induced addition of isopropylamine and piperidine to allyl acetate is described. Piperidine, however, gave N-acetylpiperidine in addition to the adduct. The acetamide was considered to be formed during treating the irradiated mixture. The aminolysis of allyl acetate with diethylamine and cyclohexylamine and of allyl chloroacetate with isopropylamine are also described. (auth)

29712 γ-INDUCED PREPARATION OF ION EXCHANGER. Vinylphosphonic Acid−Styrene Copolymer. Yamagami, M.; Fukumoto, T.; Tsurugi, J. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 108-110(1972).

γ-Induced copolymerization of styrene (M_1) and dialkyl vinylphosphonates (M_2) which were prepared by γ-induced addition reaction followed by thermolysis of the adduct was studied. When initial molar ration, M_1/M_2 is 0.2, copolymers of styrene and dialkyl vinylphosphonates contained about 50 : 50 molar ratio. Monomer reactivity ratios r_1 and r_2 were calculated to be 0.4 and 0, respectively. Hydrolysis of the copolymer with hydrochloric acid gave vinylphosphonic acid−styrene copolymer with 83 to 86% efficiencies. This functional polymer is expected to be utilized for a cation exchanger. (auth)

29713 UNSTABLE INTERMEDIATES. 133. Electron Spin Resonance Studies of 1-Monochloro and 1,1 Dichloro Radicals Formed from Irradiated Alkyl Chlorides and α-Chlorocarboxylic Acids. Mishra, S. P.; Neilson, G. W.; Symons, MC.R. (Univ. of Leicester, Eng.). J. Chem. Soc., Faraday Trans., II; 69: No. 9, 1425-1438(1973).

Exposure of various organic chlorides to ^{60}Co γ-rays gave a range of radical products detected by ESR prominent amongst which were 1-chloro radicals. Powder spectra for these radicals at S-, X- and Q-band frequencies are exemplified and interpreted with the aid of results from single crystals. The influence of the quadrupole moment of chlorine on these spectra is discussed. Methyl chloride gave mainly $H_2\dot{C}Cl$ radicals at 77°K, whilst methylene chloride gave $H_2\dot{C}Cl$ and $H\dot{C}Cl_2$ radicals. Monochloroacetic acid gave $H\dot{C}Cl(CO_2H)$ radicals at room temperature. Dichloroacetic acid gave $Cl_2\dot{C}CO_2H$ radicals, and the amide gave corresponding radicals. In aqueous or methanolic solutions dichloroacetate ions gave both $Cl_2\dot{C}CO_2^-$ and $ClC\dot{H}CO_2^-$ radicals, but trichloroacetate ions gave only $Cl_2\dot{C}CO_2^-$ radicals. (auth)

29714 STUDY OF THE BREAKING OF PHOSPHODIESTER BONDS IN POLYRIBONUCLEOTIDE CHAINS. Ekert, B. (Institut du Radium, Paris). Int. J. Radiat. Biol.; 24: No. 2, 169-188(Aug 1973). (In French).

Apart from the destructive effect observed at the level of adenine molecules, γ-irradiation of Poly A in aqueous solution produced liberation of adenine and depolymerization of the chains. It has been shown that radiochemical oxidation of the sugar induced breakage of phosphodiester bonds. The $-PO_3H_2$ radioinduced groups in the 5′ position appeared with a radiochemical yield of G = 0.35 for a dose of 150 krads, whereas the $-PO_3H_2$ groups in the 3′ position appeared with a yield of G = 0.19. When the irradiated Poly A was treated with 0.04 M KOH for 90 min at 37°C the number of radioinduced $-PO_3H_2$ groups was doubled and adenine molecules were liberated. The mechanism of these breakages is discussed on the basis of the observed experimental results. (auth)

29715 STRUCTURE OF POLYOXYMETHYLENE PRODUCED BY THE RADIATION-INDUCED, SOLID-STATE POLYMERIZATION OF TRIOXANE. Andrews, E. H.; Martin, G. E. (Queen Mary Coll., London). J. Mater. Sci.; 8: No. 9, 1315-1324(Sep 1973).

All features of the x-ray diffraction pattern of polyoxymethylene produced by radioinduced, solid-state polymerization of trioxane were examined. The heavy radial streaking observed was explained and the hexagonal unit cell dimensions were calculated. Sets of parameters were computed for chain configurations which could exist within the accuracy of the measurement, and it is shown that each configuration arises as a result of various indexing of the diffraction pattern. In conclusion it is argued that such helical structures are better described in terms of their average chain parameters rather than by attempting to define an exact unit cell height or identity period. Finally a set of values were calculated for the parameters which exactly describe the polyoxymethylene chain. (auth)

29716 GRAFT POLYMERIZATION OF ACRYLAMIDE ONTO PAPER PREIRRADIATED WITH HIGH ENERGY ELECTRONS. Lawrence, K. D. N.; Verdin, D. (Atomic Energy Research Establishment, Harwell, Eng.). J. Appl. Polym. Sci.; 17: No. 9, 2653-2666 (Sep 1973).

The graft polymerization of acrylamide onto filter paper preirradiated in air with electrons from a 200-keV accelerator was found to lead to weight increases of up to 210%. The degree of grafting depends on the radiation dose, the moisture content of the paper, and the time interval between irradiation and grafting, but is independent of the radiation dose rate. The degree of grafting increases with the monomer concentration of the reaction medium, and increases as the grafting temperature is reduced. Irradiations in the presence of O_2 or N_2 and the effect of ferrous ions in the grafting solution indicated that peroxides derived from cellulose do not contribute significantly to the initiation reactions up to 60°C. The results are consistent with the degree of grafting depending primarily on the concentration of trapped radicals present in the paper at the time of copolymerization. The cellulose in the grafted material was degraded and the grafted acrylamide was isolated and its molecular weight measured and compared with a calculated value. The moisture regain characteristics of the grafted material are reported. (auth)

29717 RADIATION-INDUCED SOLID-STATE POLYMERIZATION IN BINARY SYSTEMS. VIII. Polymerization and Foaming of Multicomponent Systems Including Acrylamide and Acrylic Acid. Kaetsu, I. (Japan Atomic Energy Research Inst., Takasaki); Ito, A.; Sagane, N. J. Appl. Polym. Sci.; 17: No. 9, 2743-2752(Sep 1973).

Radioinduced polymerization and foaming of multicomponent systems including acrylamide, acrylic acid, and foaming agents were studied. Eutectic mixtures such as acrylamide–itaconic acid were polymerized in solid state and then foamed by heating at 130 to 200°C. The solution systems such as acrylamide–itaconic acid–water and acrylamide–maleic anhydride–urea–water were polymerized in liquid and supercooled phases at higher rates and foamed to a higher degree of expansion. Foams of poly(acrylic acid) and poly(methacrylic acid) were obtained by polymerization and heating of acrylic acid (methacrylic acid)–urea–water systems. It was deduced that the nonmelting or flowing property of these acrylic polymers, especially the semithermosetting property of polyacrylamide, had an important effect on the foaming mechanism. (auth)

29718 RADIATION-INDUCED SOLID-STATE POLYMERIZATION IN BINARY SYSTEMS. IX. Polymerization and Foaming of Multicomponent Systems Including Inorganic Acid and Acrylic Monomers. Kaetsu, I. (Japan Atomic Energy Research Inst., Takasaki); Ito, A.; Sagane, N. J. Appl. Polym. Sci.; 17: No. 9, 2753-2759(Sep 1973).

It was found that binary systems consisting of inorganic acid and organic amide or nitrile form a stable glassy phase owing to the large molecular interaction between the components. The change in T_g values with change in composition of these binary systems was studied. Gamma-induced polymerization of inorganic acid and acrylamide or acrylonitrile systems was carried out in a supercooled phase. The polymerization rates in acrylamide–inorganic acid systems had a maximum at a temperature T_v (30° to 50°C higher than the glass transition temperature), but in acrylonitrile–inorganic acids systems there was no maximum rate at any temperature. Foaming occurred during irradiation in the polymerization of acrylamide–urea–sulfuric acid system. The in-source foaming was attributed to the promoting effect of sulfuric acid for the decomposition of urea and the heat accumulation by the acceleration of the polymerization. (auth)

29719 GRAFT COPOLYMER MODIFICATION OF POLYETHYLENE–POLYSTYRENE BLENDS. II. Properties of Modified Blends. Locke, C. E.; Paul, D. R. (Univ. of Texas, Austin). J. Appl. Polym. Sci.; 17: No. 9, 2791-2800(Sep 1973).

The use of graft copolymers of styrene onto polyethylene as additives to improve the mechanical properties of polyethylene–polystyrene blends is described. Blends containing equal proportions of low-density polyethylene and polystyrene were selected for this study since this composition represents the poorest balance of properties in this system. Graft addition generally increased both the yield strength and the elongation at break of the blend. Of the grafts employed, those prepared at a γ irradiation dose near 0.5 megarad appear optimal for this purpose. These conditions apparently balance the beneficial effects of grafting extent and the detrimental effects of crosslinking, both of which increase with irradiation dose. (auth)

29720 IONIZATION IN THE TRACK OF A HIGH-ENERGY ELECTRON IN LIQUID CYCLOHEXANE; PULSE RADIOLYSIS OF SOLUTIONS OF BIPHENYL IN CYCLOHEXANE. Hummel, A.; Luthjens, L.H. (Interuniversity Reactor Institute, Berlageweg 15, Delft, Te Nethehrlands). J. Chem. Phys. 59: No. 2, 654-664 (15 July 1973).

In order to study the ionization in the track of a high-energy electron in liquid cyclohexane, the lifetime distribution of the charged species is considered, with and without solutes present that can react with the species and change their mobility. Calculations of the lifetime distributions of the ions are presented, which have been made on the basis of the assumption that the precursors of the ion scavenging reactions can be considered as classically diffusing ions, initially present as pairs of oppositely charged species in each other's field. The calculations are compared with the lifetime distributions of biphenyl ions in solutions of biphenyl in cyclohexane with and without other solutes present, as determined by nanosecond pulse radiolysis. It is concluded that the precursor of the positive biphenyl ion is a positive species, which is considerably more mobile than a molecular ion. (auth)

29721 ABSENCE OF CO_2^- IN IRRADIATED SUCCINIC ACID. Premovic, P.; Gal, O.; Radak, B. (Boris Kidric Institute of Nuclear Sciences, Vinca–Belgrade, Yugoslavia). J. Chem. Phys.; 59: No. 2, 987-988(15 Jul 1973).

The ir absorption spectra from γ-irradiated and nonirradiated single crystals of succinic acid were compared with irradiated and nonirradiated malonic acid and sodium formate samples. It is evident that there is no difference between the spectra of irradiated and unirradiated samples of acids. It was concluded that the data presented contributes to the idea that the CO_2^- radicals in irradiated succinic acid do not exist and that the ESR singlet might well be attributed to a radical of the type $RCH_2\dot{C} = 0$. (DHM)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

29722 HOT-ATOM CHEMISTRY OF ^{60}Co AND ^{64}Cu IN THE MIXED CRYSTALS SYSTEM OF COBALT AND COPPER PHTHALOCYANINES. Kujirai, O.; Ikeda, N. (Tokyo Kyoiku Univ.). Radiochem. Radioanal. Lett.; 15: No. 2, 67-72(25 Sep 1973).

The chemical behavior of recoil atoms in the mixed crystals of cobalt and copper phthalocyanines was studied. The initial retention values of ^{60}Co and ^{64}Cu changed rather markedly upon dilution with the opposite component and showed different trends from each other. The difference between the retentions in the α and β modifications of the mixed crystals was investigated. (auth)

29723 ABSTRACTION OR STRIPPING OF CH_2 AS A ROUTE TO ACETYLENE FORMATION IN HOT CARBON ATOM REACTIONS. Rose, T. (Texas A and M Univ., College Station); MacKay, C. J. Phys. Chem.; 77: No. 22, 2598-2601(25 Oct 1973).

Yields of acetylene and the C_4 fragmentation products resulting from the reaction of recoil ^{11}C atoms with cyclopentene and cyclopentane show very different effects with changes in the experimental parameters. Analysis of the results shows that more than half of the acetylene is formed by a direct reaction of a hot atom rather than through an energy equilibrated intermediate, which can lead to both acetylene and the C_4 products. These conclusions are consistent with the acetylene double tracer work reported previously. (auth)

29724 STOCHASTIC AND ANALYTICAL INVESTIGATION OF TRITIUM HOT-ATOM REACTIONS. Wotzak, G.P. (Fluid, Chemical, and Thermal Processes Division, Rensselaer Polytechnic Institute, Troy, New York 12181). J. Chem. Phys. 59: No. 2, 899-906 (15 July 1973).

Detailed models for reactive and scattering phenomena have been successfully employed in the investigation of hot-atom reactions by stochastic and analytical methods. These models include an energy dependence for differential scattering cross sections and energy loss parameters. Analytical and stochastic yield results for the T–H_2, T–D_2, and T–CH_4 hot tritium systems exhibit satisfactory agreement with experimental values. (auth)

Properties of Radioactive Materials

Refer also to abstracts 29592, 29635, 29644, 29666, and 30497.

29725 (AAEC/E-276) THERMAL DECOMPOSITION OF AMMONIUM URANATES. Price, G. H.; Stuart, W. I. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1973. 27p. Dep. NTIS (U.S. Sales Only) $3.50.

Thermal decomposition of ammonium uranates in various atmospheres was studied using thermogravimetric analysis, differential thermogravimetric analysis, differential thermal analysis and ir spectrophotometry. The various stages of decomposition are discussed in terms of reaction mechanisms. The effect of nitrate impurities on thermal decomposition is briefly described. It is concluded that the ammonium uranate system at equilibrium is a continuous non-stoichiometric system with zeolitic properties. (auth)

29726 (AAEC/E-278) PERFORMANCE OF A THERMOSIPHON EVAPORATOR FOR CONCENTRATION OF URANYL NITRATE SOLUTIONS. Levins, D. M.; Alfredson, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

The performance of a thermosiphon evaporator, with a heat transfer area of 0.74 m^2, for the concentration of uranyl nitrate solutions up to 1000 gU l^{-1} is evaluated. The effects of steam pressure, uranium concentration, and liquid submergence on the overall heat transfer coefficient are reported and a method of designing thermosiphon evaporators handling concentrated uranyl nitrate solutions is proposed. Pressure drop characteristics of two packings used in the steam stripping and de-entrainment sections of the evaporator are also given. Overall heat transfer coefficients in the range 1.4 to 2.5 kW m^{-2} K^{-1} were obtained at uranyl nitrate concentrations up to 1000 gU l^{-1}. Heat transfer to uranyl nitrate solutions below a concentration of 100 gU l^{-1} was satisfactorily predicted by employing conventional heat transfer correlations using physical property data for water. Results for more concentrated solutions were successfully correlated using an empirical correction factor which accounts for the change in physical properties of the boiling solution with concentration. (auth)

29727 (CONF-730301-P2, pp 1013-1015) INFLUENCE OF MOLECULAR ENVIRONMENT ON THE (γ,n)-ACTIVATION YIELD OF THE AMINO ACID METHIONINE. Trampisch, W.; Sattler, E. L. (Univ., Giessen, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

29728 (MLM-2075) MINOR PROBLEMS IN AQUEOUS PLUTONIUM CHEMISTRY. Silver, G. L. (Mound Lab., Miamisburg, Ohio (USA)). 1 Oct 1973. Contract AT(33-1)-Gen-53. 55p. Dep. NTIS $5.45.

A method of ascertaining the acidity of the maximum concentration of trivalent and hexavalent plutonium as a function of plutonium oxidation number, and a method of estimating changes in solution acidity caused by disproportionation reactions may find application in the study of plutonium alpha coefficients. A method of ascertaining the temperature response of mixtures of plutonium ions indicates a decreased extent of disproportionation of pentavalent plutonium with increasing temperature over a narrow temperature range. The concept of representing chemical elements by polynomial equations is applied to chlorine and the reaction of plutonium with hydrogen peroxide. (auth)

29729 (RFP-2097) ENTHALPY OF SOLUTION OF URANIUM IN NITRIC ACID. Navratil, J. D.; Oetting, F. L. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 5 Oct 1973. Contract AT(29-1)-1106. 6p. Dep. NTIS $4.00.

The enthalpies of solution of uranium in 15.9 and 12.7M HNO_3 were measured calorimetrically at 25.0°C as −250.8 ± 3.3 and −242.0 ± 0.9 Kcal·mol^{-1}, respectively. Calorimetric measurements were also determined for the heat of solution of uranium in nitric acid at 38.0°C, in nitric acid containing uranium, and for different uranium-to-nitric acid ratios. (auth)

29730 ISOSTRUCTURALNESS OF THE DIPHTHALOCYANINES OF URANIUM(IV) AND THORIUM(IV). Kirin, I. S.; Kolyadin, A. B.; Lychev, A. A. (Leningrad Inst. of Nuclear Physics). Zh. Neorg. Khim.; 18: No. 8, 2295(Aug 1973). (In Russian).

The diphthalocyanine of uranium(IV) showed the following lattice parameters: a = 18.73 A, b = 15.60 A, c = 18.70, γ = 113°40′, Z = 4, B2/b. The cell parameters for the thorium(IV) compound are: a = 18.74 A, b = 15.79 A, c = 18.73 A, γ = 113°20′, Z = 4, B2/b. The isostructuralness was proven by analyzing the intensities of the reflections from both compounds. (SJR)

29731 URANYL OXALATE COMPLEXES. I. Preparation and Crystal and Molecular Structure of Ammonium Uranyl Trioxalate. Alcock, N. W. (Warwick Univ., Coventry, Eng.). J. Chem. Soc., Dalton Trans.; No. 16, 1610-1613(1973).

The preparation is reported of ammonium uranyl oxalate complexes with $UO_2 : C_2O_4$ ratios of 1:3, 1:2, and 1:1.5. The crystal structure and single-crystal visible absorption spectrum of the title compound were determined. Crystals are monoclinic, space group C2/c, a = 10.031(9), b = 11.519(10), c = 14.213(10) Å, β = 101.46(6)°, Z = 4. 1287 Observed intensities were measured by diffractometer; the structure was solved by the heavy-atom method and refined to a final R of 0.072. The crystal contains NH_4^+ and $UO_2(C_2O_4)_3^{4-}$ ions. The latter have two bidentate oxalate groups forming five-membered rings with U−O 2.43 Å, and one such group forming a four-membered ring with U−O 2.57 Å. This oxalate group has its two ends twisted relative to each other by 37°. The uranyl U−O distance is 1.69 Å, and the geometry around the uranium atom is approximately hexagonal bi-pyramidal. (auth)

29732 URANYL OXALATE COMPLEXES. III. Preparation and Crystal and Molecular Structure of Ammonium Diuranyl Trioxalate. Alcock, N. W. (Warwick Univ., Coventry, Eng.). J. Chem. Soc., Dalton Trans.; No. 16, 1616-1620(1973).

The crystal structure of the title compound was determined from photographic and diffractometer data by the heavy-atom method. Crystals are monoclinic, space group $P2_1/n$, a = 9.46(2), b = 13.61(2), c = 6.12(1) Å, β = 92.7(1)°, Z = 2. 886 Reflections were refined to a final R of 0.113. The crystal contains NH_4^+ and $[(UO_2)_2(C_2O_4)_3]_n^{2n-}$ ions. In the latter, one oxalate group is ter- and one quadridentate, giving double chains parallel to c. Mean U−O distances are 1.77 (uranyl) and 2.38 Å (to oxalate). The structures and bonding of oxalato- and other complexes of UO_2^{2+} are discussed. (auth)

29733 NEW CHEMILUMINESCENT REACTION: THE OXIDATION OF SULFUR COMPOUNDS BY OZONE IN CONCENTRATED SULFURIC ACID IN THE PRESENCE OF URANYL. Parshin, G. S.; Bulgakov, R. G.; Kazakov, V. P. (Inst. of Chemistry, Sverdlovsk, USSR). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 162-163(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 182-183(1973).

The bright chemiluminescence produced by the electrochemical reduction of solutions of uranyl in sulfuric acid is the result of the interaction of anodic electrolysis products with the cathodic products. It is suggested that an important part is played by the reactions of ozone, a product of the electrolysis of sulfuric acid, with sulfur-containing products of its reduction at the cathode. It was found that if sulfur compounds in a low oxidation state are added to a solution of ozone in sulfuric acid, there is an emission of bright green light easily visible in a slightly darkened room to the naked unadapted eye. The light is the same as that of the photoluminescence of UO_2^{2+} in concentrated H_2SO_4. It appears that uranyl is an efficient acceptor of the energy of excitation of the SO_2 formed during the oxidation of sulfur and sulfur compounds by ozone in concentrated sulfuric acid. (DHM)

29734 CHEMILUMINESCENCE DURING THE CATHODIC REDUCTION OF SOLUTIONS OF URANYL AND OZONE IN 5 M H_2SO_4. Parshin, G. S.; Bulgakov, R. G.; Kazakov, V. P.; Dmitrieva, E. V. (Inst. of Chemistry, Sverdlovsk, USSR). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 160-161(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 181-182(1973).

The chemiluminescence due to the reaction of ozone with the cathodic-reduction products of solutions of UO_2^{2+} in 5 M H_2SO_4 was investigated. It was suggested that the rise in emission intensity during electrolysis (at a potential of +0.3V) is induced mainly by the chemiluminesent reaction between U^{4+} and ozone. The electrolysis is accompanied initially by emission rising to a maximum and then decreasing. As electrolysis proceeds the ozone concentration falls, and at the moment when emission practically ceases, no ozone can be detected in the solution. In oxygen-saturated solutions, emission is also observed in the absence of ozone in the potential range 0.3 to 0 V. This seems to be due to reaction of H_2O_2 with U^{4+} ions. Its brightness, however, is two orders lower than in the presence of ozone. (DHM)

29735 REACTIONS OF ACCELERATED T^+ IONS WITH SOLID BENZENE. Firsova, L. P. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 2, 96-98(1973).

Translated from Khim. Vys. Energ.; 7: No. 2, 109-112(1973).

Labeled product yields from bombardment of solid benzene with T^+ ions were determined. The tritium ion energies were varied from 0.15 to 3.0 keV. During the course of bombardment, new layers of benzene were applied continuously on the absorbing target by condensation of the vapor. In contrast to earlier results in the stationary case, it was found that the product yields do not depend on initial ion energy within experimental error for a target with continuously changing thickness. Solu-

tions of the diffusion equations for the stationary and quasi-stationary cases indicate that the nature of the energy dependence of the product yields can differ under these conditions. (auth)

29736 CRYSTAL STRUCTURE OF COMPLEX TECHNETIUM COMPOUNDS. II. $[(CH_3)_4N][Tc^{V}(NCS)_6]$. Hauck, J.; Schwochau, K.; Bucksch, R. (Kernforschungsanlage, Juelich, Ger.). Inorg. Nucl. Chem. Lett.; 9: No. 9, 927-929(Sep 1973). (In German).

The crystal structure of the technetium(V) hexathiocyanato complex was analyzed from its tetramethylammonium salt, using the line intensities of powder diagrams. The $[(CH_3)_4N]$ groups and $[Tc(NCS)_6]$ complexes have a rhombohedrally distorted CsCl structure akin to that of $Tl[SbF_6]$. The c/a ratio of the hexagonal unit cell of $[(CH_3)_4N]$ $[Tc(NCS)_6]$ is 1.46. As compared with the $[SbF_6]$ octahedra of $Tl[SbF_6]$, the $[Tc(NCS)_6]$ octahedra are turned by about 30° relative to the three-figure axis. (UK)

29737 URANYL OXALATE COMPLEXES. II. Preparation and Crystal and Molecular Structure of Ammonium Uranyl Dioxalate. Alcock, N. W. (Warwick Univ., Coventry, Eng.). J. Chem. Soc., Dalton Trans.; No. 16, 1614-1616(1973).

The crystal structure of the title compound was determined from diffractometer data by the heavy-atom method. Crystals are triclinic, space group $P\bar{1}$, a = 12.91(2), b = 7.20(1), c = 6.31 (1) Å, α = 110.56(5), β = 107.85(5), γ = 84.25(5)°, Z = 2. 1351 Reflections were refined by least squares to a final R of 0.130. The crystal contains NH_4^+ and $[(UO_2)(C_2O_4)_2]_n^{2n-}$ ions. In the latter one oxalate group is bidentate, and one bidentate to one uranium atom and unidentate to another, giving chains parallel to c. Mean distances are U-O(uranyl) 1.77, and U-O(oxalate) 2.37 Å. (auth)

29738 KINETICS AND MECHANISM OF THE Ce(IV)-U(IV) REACTION IN ACIDIC SULPHATE MEDIA. El-Tantawy, Y. A.; Abu-Shady, A. I. (Kuwait Univ.). Z. Phys. Chem. (Frankfurt); 84: No. 5-6, 225-240(1973).

In acidic sulphate media where the ratio of the concentration of HSO_4^- to that of the oxidant-reductant system exceeded the maximum coordination number of any of the reacting species, the kinetics and mechanism of the reaction 2Ce(IV) + U(IV) = 2Ce(III) + U(VI) were investigated. The reaction was found to obey overall second order kinetics. Over the temperature range from 6 to 15°C, the specific second order rate constant obeyed Arrhenius behavior with an energy of activation calculated to be 17.0 ± 0.4 kcal/mole, compared to 14.6 kcal/mole reported for the reaction in absence of HSO_4^-. The overall rate of the reaction was found to, generally, decrease with increasing $[HSO_4^-]$ or decreasing $[H^+]$. (GE)

29739 RADIOCHEMICALS 1973/74. Amersham, Eng.; Radiochemical Centre (1973). 115p.

A catalogue is presented of the radioactive chemicals for research offered by the Radiochemical Center, Amersham. A general section describes ordering and supply details, including licensing and registration. A section follows on nomenclature, quality control, specific activity, storage, product information, availability and packaging, and other technical information. The main part of the catalogue follows, with product specifications and prices. Sections describe tritium labelling services, reactor irradiation service, standards for liquid scintillation counting, and structural formulae. (UK)

29740 HYDROLYSIS PRODUCTS OF URANYL FLUORIDE WITH WATER VAPOR. Seleznev, V. P.; Tsvetkov, A. A.; Sudarikov, B. N.; Gromov, B. V.; Ivankova, T. F. (Moscow Inst. of Fine Chemical Tech.). Zh. Neorg. Khim.; 18: No. 8, 2168-2175 (Aug 1973). (In Russian).

Hydrolysis of uranyl fluoride was studied over the temperature interval of 420 to 580°C and partial water vapor pressures of 0.2 to 0.7 atm. The surface area of the samples was 3.4 m^2/g, and the particle size was 40 to 60 microns. The mass of UO_2F_2 subjected to treatment with water vapor was ~2 g per experiment with a layer height of 0.3 to 0.4 mm. The samples were heated in a nickel reactor equipped with an electric heater. At 420 to 455°C the reaction products still show a significant amount of uranyl fluoride which is completely converted only at 500°C or higher. Hydrolysis of UO_2F_2 is accompanied by the dissociation of the alpha- and beta-modifications of uranium trioxide formed in the course of the reaction. As a result of the thermal decomposition of the trioxide the hydrolysis products have a variable composition which depends on the temperature, reaction time, and partial water vapor pressure. Increasing the water vapor concentration increases the yield of beta-UO_3 in the hydrolysis of uranyl fluoride. (SJR)

29741 FORMATION OF ORGANIC IODIDES ON HEATING NITRIC ACID SOLUTIONS CONTAINING CARRIER-FREE IODINE-131. Nakamura, K.; Saeki, M.; Tachikawa, E. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 367-373(Jun 1973).

When nitric acid solution containing carrier-free ^{131}I was heated, a fraction of the ^{131}I was converted to organic iodides, among which methyl iodide was a major component. The yield of organic iodides showed a strong dependence on the concentration of nitric acid. Furthermore, the yield curve referred to reaction time revealed the particular characteristic of a hump appearing in the case of diluted nitric acid solutions. The distribution of ^{131}I among the various oxidation states in the acid solution was also studied in its relation to reaction time. The results obtained indicate that organic iodide formation is related with the $I^0 - IO_3^-$ oxidation step. The yield curve of the organic iodides is discussed qualitatively, by assuming an intermediate state I^* existing between two extreme states of oxidation. (auth)

29742 MOLECULAR VOLUMES AND EQUIVALENT CONDUCTIVITIES IN THE $ThCl_4$-KCl SYSTEM. Yoshida, S.; Syano, T.; Kuroda, T. (Tokyo Inst. of Tech.). Denki Kagaku; 41: No. 6, 427-430(Jun 1973). (In Japanese).

The nature of the fused $ThCl_4$-KCl system was investigated by measuring densities and specific conductivities of the system. The densities obtained showed large positive deviation at about 0.35 molar fraction of $ThCl_4$ from the additive values of this system. It seems that the values for density represent more clearly the nature of the fused salt than do those for molecular volume, when the mean molecular weight of the salt is great, as in this case. The equivalent conductivities and the relevant temperature coefficients, which were calculated from the measured specific conductivities and the densities, exhibited a maximum deviation from the additive values at about 0.35 molar fraction of $ThCl_4$. These results indicated, on the basis of Bloom's law for the conductivity of binary fused salt systems, that the complex ions $[ThCl_7]^{3-}$ and $[ThCl_5]^-$ may exist in the fused $ThCl_4$-KCl system. (auth)

29743 VIBRATIONAL SPECTRUM AND NORMAL COORDINATE ANALYSIS OF CrO_3Br^- FOR ASSIGNING THE VIBRATIONAL SPECTRA OF MOLECULES AND IONS OF THE TYPE Mo_3X^{n-} (M = Cr, Mn, Tc, Re; X = F, Cl, Br, S; n = 0,1). Mueller, A. (Univ., Dortmund, Ger.). Spectrochim. Acta, Part A; 29: No. 10, 1773-1788(Oct 1973). (In German).

The ir, laser Raman spectra and a normal coordinate analysis of CrO_3Br^- are reported. The assignments of CrO_3F^-, CrO_3Cl^-, CrO_3Br^-, MnO_3F, TcO_3Cl, ReO_3Cl, ReO_3Br are discussed and theoretically interpreted with a view to eliminate some inconsistencies in the assignments for the A_1 vibrations. Since the Raman spectral data of ReO_3S^- can be used to interpret the spectrum of ReO_3Cl, the Raman spectra of this ion were measured in aqueous solution. (auth)

29744 PROPERTIES OF AQUEOUS THORIUM NITRATE SOLUTIONS. II. Water Activities and Osmotic and Activity Coefficients of Thorium Nitrate at 25, 35, and 45°C. Apelblat, A.; Azoulay, D.; Sahar, A. (Israel Atomic Energy Commission, Beersheba). J. Chem. Soc., Faraday Trans., I; 69: No. 9, 1624-1627(1973).

Data from vapour pressure osmometry at concentrations below 0.2 mole kg^{-1}, and from vapour pressure measurements for higher concentrations, were used to calculate water activities and osmotic and activity coefficients of thorium nitrate in aqueous solutions at 25, 35, and 45°C over a wide range of concentrations. Data were previously published for 25°C only; these differ significantly from the present results. (auth)

29745 PROPERTIES OF AQUEOUS THORIUM NITRATE SOLUTIONS. I. Densities, Viscosities, Conductivities, pH, Solubility, and Activities at Freezing Point. Apelblat, A.; Azoulay, D.; Sahar, A. (Israel Atomic Energy Commission, Beersheba). J. Chem. Soc., Faraday Trans., I; 69: No. 9, 1618-1623(1973).

The solubility of $Th(NO_3)_4$ in water is a linear function of temperature in the range 5 to 60°C. The density was measured at concentrations up to saturation, at 25 to 60°C, and the conductivity and pH of $Th(NO_3)_4$ solutions were determined at the same temperatures. The equivalent conductivity at infinite dilution was 72, 89, 104, 123 Ω^{-1} cm^2 $equiv.^{-1}$, at 25, 35, 45, 60°C, respectively, after correction for a hydrolysis reaction. The viscosity increases greatly at about 1 mol l^{-1} concentration. Depression of freezing points was determined, the lowest point attained being -37°C, which corresponds to a 2.9 mol kg^{-1} solution. (auth)

29746 EXCESS RADIOACTIVITY OF TRYPSIN MIXTURES. Frohlich, A.; Sadeh, D. (Tel-Aviv Univ., Israel). Biophys. J.; 13: No. 7, 601-602(Jul 1973).

The radioactivities of mixtures of trypsin and HB_3O_3 or LiCl were measured and compared with the radioactivity of the constituents. No evidence was found for the production of heavy particles, as had been previously reported, neither were the excess counting rates of the mixtures over that of its constituents as large. The residual excess radioactivity was about four orders

of magnitude smaller than that published, yet was still statistically significant, consisting mainly of electrons having a maximum energy less than about 400 keV. The excess radioactivity of a mixture of trypsin and LiCl had a probable half-life between 5 and 46 days. Possible mechanisms for these excesses are discussed. (auth)

29747 NEPTUNIUM(IV) ARSENATES. Meramedjian, N.; Pages, M.; Freundlich, W. (Institut du Radium, Paris). Compt. Rend., Ser. C; 277: No. 1, 23-24(2 Jul 1973). (In French).

Neptunium(IV) arsenates were obtained by direct reactions between the anhydride, As_2O_5 and the dioxide, NpO_2. The operating conditions, thermal stability and x-ray diffraction spectra of the compounds produced are presented. (FR)

29748 BETA-DIKETONE CHELATE COMPLEXES WITH URANIUM(IV), THORIUM(IV), AND CERIUM(IV). Yoshimura, T.; Miyake, C.; Imoto, S. (Osaka Univ.). Bull. Chem. Soc. Jap.; 46: No. 7, 2096-2101(Jul 1973).

The tetrakis-β-diketonates of U(IV), Th(IV), and Ce(IV) with acetylacetone, trifluoroacetylacetone, hexafluoroacetylacetone, benzoylacetone, dibenzoylmethane, benzoyltrifluoroacetone, and thenoyltrifluoroacetone were prepared and their ir spectra measured in the range 4000 to 200 cm^{-1}. In every chelate, a strong, broad and metal sensitive band related to the M-O stretching mode was found in the 200 to 250 cm^{-1} region. (auth)

29749 CHEMISTRY OF URANIUM FLUORIDES AND OXIDE FLUORIDES. II. Preparation and Vibrational Spectra of α- and β-Uranium Pentafluoride. Jacob, E. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Anorg. Allg. Chem.; 400: No. 1, 45-50 (Aug 1973). (In German).

By reaction of a saturated solution of UF_6 in anhydrous HF with HBr β-UF_5 was prepared in a simple manner. β-UF_5 was changed into α-UF_5 by heating in the presence of UF_6. The ir and Raman spectra of the dimorphs are reported and discussed. (auth)

29750 DECOMPOSITION OF H_2O_2 IN PRESENCE OF MIXED OXIDE CATALYSTS. (Bangalore Univ., India). Z. Anorg. Allg. Chem.; 400: No. 1, 83-88(Aug 1973).

The decomposition of H_2O_2 in presence of TiO_2-ZrO_2 (ignited to various temperatures), SiO_2-ZrO_2, $Al_2O_3-ThO_2$, SiO_2-ThO_2, $Al_2O_3-MoO_3$, SiO_2-MoO_3, $Al_2O_3-WO_3$ and SiO_2-WO_3 mixed oxide catalysts was studied. As these catalysts are of bifunctional nature an attempt was made to evaluate the decomposition brought about by acidic as well as by the basic sites by the poisoning technique. Both these sites catalyse the decomposition of H_2O_2. The energy of activation values E_a and E_b are inversely proportional to the acidity and basicity values. The mechanism of decomposition of H_2O_2 in presence of acidic and basic sites is of similar nature. Only acid sites having an acid strength in the range of pKa values $< +3.3$ and > -3.0 are able to catalyse the decomposition of H_2O_2. Basic centres which are strong as well as those which are moderately weak (pKa ≥ 10) are able to catalyse. (auth)

29751 EFFECT OF ZIRCONIUM ON THE SOLUBILITY OF URANIUM IN LIQUID ZINC. Volkovich, A. V.; Nichkov, I. F.; Raspopin, S. P.; Lyazgin, B. I. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 3, 296-297(Mar 1973).

Translated from Zh. Fiz. Khim.; 47: No. 3, 519-521(Mar 1973).

The effect of zirconium on the solubility of uranium in liquid zinc at 755°C was investigated by an e.m.f. method. Small amounts of added zirconium increase the solubility of uranium in zinc but larger amounts of zirconium cause its gradual diminution. (auth)

29752 MOBILITY SPECTRA OF RADON DAUGHTER AEROSOLS STORED IN A VESSEL. Mochizuki, S.; Sekikawa, T. (Science Univ., Tokyo). J. Radiat. Res.; 14: No. 2, 144-152(Jun 1973).

The time variation in the mobility spectrum of radioactive charged particles, stored in a closed vessel, and the concentration ratio of positive to negative particles were studied by using a mobility spectrometer of parallel plates type. A remarkable variation in the mobility spectrum with the mobility ranging from 3×10^{-2} $cm^2/V \cdot s$ to 3×10^{-4} $cm^2/V \cdot s$ was observed during four hours. A small hump appeared in the spectrum of mobility ranging from 1×10^{-2} $cm^2/V \cdot s$ to 1×10^{-3} $cm^2/V \cdot s$ under the condition that the radioactive equilibrium state was held in the vessel. The concentration ratio in each fine range of mobility was distributed from 1 to 1.5. (auth)

29753 2,2'-BIPYRIDINE N,N'-DIOXIDE COMPLEXES WITH SOME URANYL SALTS. Ahuja, I. S.; Singh, R. (Banaras Hindu Univ., India). Spectrochim. Acta, Part A; 29: No. 10, 1879-1883 (Oct 1973).

Coordination compounds formed by uranyl chloride, sulphate, nitrate and thiocyanate with 2,2'-bipyridine N,N'-dioxide were prepared and characterized by infrared spectral measurements down to 200 cm^{-1} in the solid state. Possible coordination arrangement around the uranyl group in these complexes is discussed. (auth)

29754 RAMAN SPECTRA OF THORIUM(IV) FLUORIDE COMPLEX IONS IN FLUORIDE MELTS. Toth, L. M.; Boyd, G. E. (Oak Ridge National Lab., TN). J. Phys. Chem.; 77: No. 22, 2654-2657(25 Oct 1973).

Raman spectra of $LiF-NaF-ThF_4$ mixtures at 650°C were examined to establish the coordination behavior of Th(IV) in molten fluorides. Eight coordinated Th(IV) was identified in melts with excess fluoride ion by comparing their spectra with that of crystalline K_5ThF_9. Seven coordinated Th(IV), present in fluoride ion deficient melts, was identified by shifts in the frequency of ν_1 with melt composition changes. These results are compared with previous coordination studies of U(IV) and Zr(IV). (auth)

29755 STRUCTURAL AND THERMAL INVESTIGATIONS ON SOME TETRA OXALATO COMPLEXES OF URANIUM (IV). Awasthi, S. K.; Chawla, K. L.; Chackraburtty, D. M. (Bhabha Atomic Research Centre, Bombay). J. Inorg. Nucl. Chem.; 33: No. 11, 3805-3810(Nov 1973).

The preparation and characterization of tetraoxalato complexes of uranium (IV) with ammonium, potassium and caesium are described. The x-ray data of the complexes $(NH_4)_4U(C_2O_4)_4 \cdot 6H_2O$ and $K_4U(C_2O_4)_4 \cdot 5H_2O$ were obtained. The results of thermal analysis, ir and magnetic measurements are also reported. (auth)

29756 THERMAL DECOMPOSITION AND THERMODYNAMIC PROPERTIES OF URANIUM PENTABROMIDE. Blair, A.; Ihle, H. (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 33: No. 11, 3795-3803(Nov 1973).

The thermal decomposition of uranium pentabromide was studied; and the free energy and standard heat of formation of this compound were measured. The standard heat of formation of UBr_5 was found to be $\Delta H^f_{298} = -197.5 \pm 1.3$ kcal/mole. Only at temperatures below 80°C was an apparent equilibrium established, whereby a constant bromine vapour pressure could be measured; at higher temperatures, the compound decomposes irreversibly into uranium tetrabromide and liquid bromine. At 80°C the free energy of formation of UBr_5 from UBr_4 and bromine vapour is $\Delta G = -0.3$ kcal/mole, and by extrapolation would be zero at about 100°C. The cause of the irreversible decomposition above 80°C is not known, but it may be associated with a change in crystal structure. (auth)

29757 PREPARATION AND ASSIGNMENT OF THE INFRARED SPECTRUM OF THE NEW MIXED TECHNETIUM-COBALT CARBONYL. $CoTc(CO)_9$. Sbrignadello, G.; Tomat, G.; Magon, L.; Bor, G. (Consiglio Nazionale delle Ricerche, Padua). Inorg. Nucl. Chem. Lett.; 9: No. 10, 1073-1077(Oct 1973).

The hitherto unknown mixed carbonyl $(CO)_4Co-Tc(CO)_5$ was prepared and its ir spectrum examined. A tetrahydrofuran solution of $Co_2(CO)_8$ was stirred with excess of freshly prepared Na/K alloy under CO, causing reduction to $[Co(CO)_4]^-$. The use of CO rather than N_2 or Ar as protecting gas was necessary to complete the reaction and to obtain a colourless solution free of the red trinuclear anion $[Co_3(CO)_{10}]^-$. The reaction was complete within 1-hr. at room temperature. $BrTc(CO)_5$ was then prepared by adding a CCl_4 solution of Br_2 to a CCl_4 solution of $Tc_2(CO)_{10}$ and stirring under N_2 for 1 day. The solvent was removed under vacuum, $BrTc(CO)_5$ remaining as a colourless solid. This was dissolved in tetrahydrofuran and the solution added to excess of the THF solution of the $[Co(CO)_4]^-$, stirring at room temperature under CO. The $CoTc(CO)_9$ was purified chromatographically. It formed yellow crystals, soluble in common organic solvents. Its ir spectrum in the C-O stretching region is shown and discussed. (UK)

Radioactive Waste Treatment

Refer also to abstract 29871.

29758 (BNWL-1765) REVIEW OF LEACHING TEST METHODS AND THE LEACHABILITY OF VARIOUS SOLID MEDIA CONTAINING RADIOACTIVE WASTES. Mendel, J. E. (comp.) (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1973. Contract AT(45-1)-1830. 50p. Dep. NTIS $5.45.

A review of experimental techniques that have been employed to measure the leachability of solidified radioactive wastes in the United States and foreign countries is made. Factors which effect leachability are described. The need for two different kinds of leach tests is emphasized, (1) a rapid comparison test, and (2) a more comprehensive performance test, wherein the actual exposure environment is simulated. (auth)

29759 (CONF-720823-P1) PROCEEDINGS OF THE TWELFTH AEC AIR CLEANING CONFERENCE HELD AT OAK RIDGE, TENNESSEE, AUGUST 28-31, 1972. First, M. W. (ed.) (Harvard Univ., Boston, Mass. Harvard Air Cleaning Lab.). Jan 1973. 509p. Dep. NTIS $21.20 (2 volumes).

Abstracts were prepared for nineteen of the twenty-eight papers

presented. Nine papers appeared previously in NSA and can be located in the report number index at CONF-720823. (DHM)

For abstracts of individual papers see: 29760–29765, 29856–29860, 29984, 29985, 31795, 31803, 31854, 31877, 31878, and 31907.

29760 (CONF-720823-P1, pp 28-47) MEASUREMENT OF DYNAMIC ADSORPTION COEFFICIENTS FOR NOBLE GASES ON ACTIVATED CARBON. Siegwarth, D. P.; Neulander, C. K.; Pao, R. T.; Seigler, M. (General Electric Co., San Jose, CA). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Experimental techniques and analytical procedures were developed to measure the noble gas dynamic adsorption coefficients on activated carbon with a continuous inlet noble gas flow rather than the normal radioactive tracer pulse injection method. Nonradioactive krypton or xenon was blended with dry air to a concentration of 1 to 10 ppM by volume and continuously fed to the inlet of the test adsorber. The adsorber effluent was divided to permit sample storage as well as real-time analyses. The experimental work was performed with $1^1/_4$- or 2-in. diameter adsorber columns 2 to 8 ft long. To measure a few parts per million of krypton or xenon in air, special analytical techniques were developed to preconcentrate the samples. The breakthrough curves were established by quantitatively measuring the adsorbate concentration in the carbon adsorber effluent with an ultrasonic detector gas chromatograph. The dynamic adsorption coefficients (k_d) were calculated from: $k_d = F\,t_m/M$ where k_d = dynamic adsorption coefficient [cc(20°C, 1 atm ≡ STP)/gm]; F = gas flow rate [cc(STP)/min]; t_m = adsorbate mean residence time (min); M = mass of dry carbon (gm). The experimentally determined dynamic adsorption coefficients were in close agreement with those previously reported in the literature for other carbons. The equilibrium stage theoretical model adequately described the measured breakthrough curves. (auth)

29761 (CONF-720823-P1, pp 48-59) EFFECT OF HIGH PRESSURE AND LOW TEMPERATURE ON THE ADSORPTION OF XENON AND KRYPTON FROM HELIUM AND ARGON STREAMS. Ratney, R. S.; Underhill, D. W. (Harvard School of Public Health, Boston). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The dynamic adsorption coefficients of krypton on activated charcoal from streams of argon and helium were measured at temperatures from −140°C to 0°C and at pressures from 15 psig to 135 psig. Xenon was studied only at 37°C because measurements were not practicable at low temperatures. The adsorption coefficient is considerably higher from helium streams than from argon at all temperatures and pressures studied, and in both cases it increases markedly as the temperature is decreased. Increased pressure causes a proportional increase in adsorption coefficient and the slope of the coefficient-pressure line increases as the temperature decreases with helium as the carrier. With argon, the slope is small and relatively unaffected by temperature above −120°C. At −120°C pressure has almost no effect on the adsorption coefficient and at −140°C the coefficient decreases markedly with increasing pressure up to about 75 psig and then increases gradually above that. (auth)

29762 (CONF-720823-P1, pp 71-85) MASS AND HEAT TRANSFER OF KRYPTON–XENON ADSORPTION ON ACTIVATED CARBON. Kovach, J. L.; Etheridge, E. L. (Nuclear Consulting Services Inc., Columbus, OH). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

A large number of boiling water reactors are being equipped with ambient temperature-carbon adsorption off-gas systems. The selection of adsorbent for these systems is often based on limited experimental data resulting in non-optimized processes. The data presented here was generated to assist in the selection of the adsorbent and operating conditions for the off-gas systems utilizing the ambient or near ambient adsorption process. (auth)

29763 (CONF-720823-P1, pp 417-433) DEVELOPMENTS IN THE REMOVAL OF AIRBORNE IODINE SPECIES WITH METAL SUBSTITUTED ZEOLITES. Pence, D. T.; Duce, F. A.; Maeck, W. J. (Allied Chemical Corp., Idaho Falls, ID). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

A number of metal-exchanged zeolites were investigated for possible use in airborne radioiodine removal. Although some show promise in dry atmospheres or heated adsorption bed applications, none compare with silver zeolite for overall adsorption efficiency for radioiodine. The radioiodine adsorption efficiencies and structural properties were examined in such adverse environmental conditions as high temperature steam atmospheres, high radiation fields, and high levels of various contaminant gases. A series of tests are described in which adsorption efficiencies of several adsorbent materials were examined as a function of airborne methyl iodide concentration. The results of these tests indicate that not enough is known about the adsorption performance of the commonly used radioiodine adsorbents to assure that the required DFs can be obtained to meet the specified radioiodine concentration levels with the present adsorbent systems. (auth)

29764 (CONF-720823-P1, pp 434-444) TESTING OF IODINE FILTER SYSTEMS UNDER NORMAL AND POST-ACCIDENT CONDITIONS. Wilhelm, J. G.; Dillmann, H. G.; Gerlach, K. (Kernforschungszentrum, Karlsruhe, Ger.). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The method used in the German Federal Republic for testing iodine filters in nuclear installations includes testing of the adsorber material under simulated normal operating and post-accident conditions, and in-place tests of the whole filter system. The interval between in-place tests is extended by the use of bypass adsorber beds fitted parallel to the original iodine adsorber bed to get information with respect to aging and poisoning of the adsorber material. Test results will be given for filter systems with small and large bed depths. The differential removal efficiency of the successive charcoal layers in deep bed adsorbers, including the effects of aging and poisoning as a function of bed depth and air-change, will be discussed. A very recently built test facility is described for testing of original off-gas filter components. The test facility is equipped to perform tests of demisters, HEPA-filters, iodine adsorbers and other components operating under simulated normal and post-accident conditions of a gas-cleaning system in water cooled reactors. The operational conditions which can be reached with this installation are: gas flow up to 2000 m^3/h, temperatures up to 200°C, and pressures up to 5 at (~75 psi). Tests can be performed with dry and wet air, air-steam mixtures and pure steam. The relative humidity can be controlled within ±3%. The effect of condensation and the removal of droplets by filter components can be measured by use of a water spray generator at temperatures up to 150°C. The generator is dimensioned for simulating condensation rates which correspond to a dew-point difference of up to 100°C between the air-steam mixture in the reactor containment and the off-gas upstream of the filter system. (auth)

29765 (CONF-720823-P1, pp 445-468) CORRELATION OF RADIOIODINE EFFICIENCIES RESULTING FROM A STANDARDIZED TEST PROGRAM FOR ACTIVATED CARBONS. Rivers, R. D.; Pasha, M.; Buckler, W. H. (American Air Filter Co. Inc., Louisville, KY). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Considerable data has been reported on the efficiency of activated carbons, both impregnated and unimpregnated, on radioiodine and its compounds. Unfortunately, the characterization of the carbons tested has been very sketchy, being limited mostly to brand names and nominal mesh size. Radioisotope efficiency tests were carried out on 30 lots of carbon from five sources under both normal and post LOCI conditions. These tests demonstrate substantial lot-to-lot variance in efficiency, even of the same supplier grade. Some correlation between these efficiencies, carbon physical parameters and test parameters was obtained. A standardized test pattern is proposed for evaluating nuclear service adsorption media. This includes a system for mounting test canisters in parallel with installed carbon cells, so that media samples can be given the same exposure as the cells themselves. These canisters are removed periodically and tested with radioisotopes under post-LOCI conditions, thus demonstrating current performance of the installed cells. (auth)

29766 PRODUCTION OF RADIOACTIVE WASTES. General Principles Concerning the Relevant Administration. Olivier, J. P. (European Nuclear Energy Agency, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 100, 6-13(Mar 1973). (In French).

From meeting on administrative developments in the treatment of radioactive wastes; Paris, France. (4 Apr 1973).

The origin of radioactive wastes (processing of ore, preparation of fuels, nuclear reactors, reprocessing of fuels, etc.) is considered together with the relative importance of these various sources of waste. The general principles concerning the handling of the

various forms of waste (liquid, solid) are presented. Current work carried out in this field must find a solution to the pressing international problem of confining high activity wastes. (FR)

29767 QUARTZ MATRIX ISOLATION OF RADIOACTIVE WASTES. McCarthy, G. J. (Pennsylvania State Univ., University Park). J. Mater. Sci.; 8: No. 9, 1358-1359(Sep 1973).

A proposed method of storing radioactive wastes is to melt them into glass-forming compositions, and solidify this melt in storage containers. Certain ceramics would be ideal for this purpose. However, the temperatures necessary to form mixtures of these wastes and most ceramics into dense solids are much higher than those now employed in waste solidification processes. It is proposed, therefore, that with the ceramic processing technique, hot-pressing, a dense solid may be formed out of the radioactive waste and a low-leachability crystalline or glassy matrix at or below 1000°C. Common sand (quartz) was chosen as one matrix material. The preliminary results are described. (UK)

Radioisotope Production

Refer also to abstracts 29781 and 30760.

29768 (CONF-730301-P2, pp 1179-1184) PRODUCTION OF RADIOISOTOPES FOR BIOMEDICAL STUDIES USING PHOTONUCLEAR REACTIONS. Welch, M. J. (Washington Univ., St. Louis, MO). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Photonuclear reactions can be used to produce radioisotopes of use in biomedical science, although in general the specific activity is low. The possible yields of medically interesting short-lived radioisotopes that could be obtained from an electron accelerator designed for radiation therapy are discussed. Targets that could be used to produce high specific activity compounds labeled with ^{15}O, ^{13}N, ^{11}C, and ^{18}F are evaluated. (auth)

29769 SEPARATION OF LEAD-210 FROM POLONIUM-210 AND BISMUTH-210. Kirby, H. W. (To United States Atomic Energy Commission). US Patent 3,758,663. 11 Sep 1973. Filed date 18 May 1972. 6p.

A method is reported for the separation of lead-210 from polonium-210 and/or bismuth-210 by disposing a solution containing at least two of the nuclides, one of which is lead-210, on a platinum substrate. The solutions are evaporated, followed by selective leaching or desorbing the lead-210 with a reagent. The most effective reagent tested was NH_4Cl. (auth)

29770 SEPARATION OF CALIFORNIUM FROM OTHER ACTINIDES. Mailen, J. C.; Ferrid, L. M. (To United States Atomic Energy Commission). US Patent 3,761,564. 25 Sep 1973. Filed date 24 Jan 1972. 4p.

A method is reported for separating californium from a fused fluoride composition containing californium and at least one element selected from the group consisting of plutonium, americium, curium, uranium, thorium, and protactinium. The flouride composition is contacted with a liquid bismuth phase containing sufficient lithium or thorium to effect transfer of the actinides to the bismuth phase. The liquid bismuth phase is then contacted with molten LiCl to effect selective transfer of californium to the chloride phase. (auth)

29771 TROMBAY DEVELOPS A TECHNETIUM "COW". Nucl. India; 11: No. 5, 1; 7 (Jan 1973).

Technetium-99m, a very short lived isotope, (half-life 6 hours), is widely used for diagnostic procedures, including the scanning of the brain, bone, liver, lung, thyroid and placenta. It can be separated in a pure form from its parent ^{99}Mo, (half-life 67 hours), which is produced in a nuclear reactor. The Isotope Division of the Bhabha Atomic Research Center developed a simple ^{99m}Tc "Cow", which uses ^{99}Mo, produced in the CIRUS research reactor at Trombay. The Trombay-developed ^{99m}Tc "Cow" differs from that produced in many advanced countries in as much as it uses low specific activity ^{99}Mo readily produced in any research reactor. The pertechnetate milked out from the "Cow", is of high concentration and purity. Such "Cows" have been supplied to six leading hospitals. (INIS)

29772 PREPARATION OF PURE CARRIER-FREE ^{123}Xe FOR RARE-GAS WASHOUT STUDIES. Loberg, M. D.; Phelps, M. E.; Welch, M. J. (Washington Univ., St. Louis). J. Nucl. Med.; 14: No. 10, 733-739(Oct 1973).

The production of pure ^{123}Xe is considered for use as a tracer in rare-gas washout studies. The major contaminant in ^{123}Xe produced by the $^{122}Te(^3He,2n)^{123}Xe$ nuclear reaction was found to be ^{122}Xe, and the conditions for minimizing the ^{122}Xe impurity are discussed. The magnitude of this contamination is compared with that predicted from a compound statistical model calculation, and good agreement is obtained between the theoretical and experimental ratio of $^{122}Xe/^{123}Xe$ as a function of bombarding energy. The analysis is then extended to the production of ^{123}Xe by the alpha-particle bombardment of ^{122}Te. It is suggested that this model can be applied to estimate theoretically amounts of impurities when producing radionuclides by cyclotron irradiation in cases where the reaction cross sections are unknown. (auth)

29773 ISOTOPE GENERATORS. Present Status and Future Development. Henry, R. (CEN de Saclay, Gif-sur-Yvette, France). J. Nucl. Biol. Med.; 15: No. 4, 105-107(Oct 1971).

From 12th conference of Italian society for nuclear biology and medicine; Florence, Italy (3 Nov 1970).

The rapid expansion of in vivo uses of radioisotopes in the field of radiopharmaceuticals has been encouraged by the increased use of isotope generators. The advantages of these generators outweigh any difficulties experienced in handling them. The advantages are given as: (1) the daughter isotope usually offers dosimetric characteristics more satisfactory than those of any competing isotope of a longer half-life which could be obtained ready to use. (2) the daughter isotope must offer nuclear properties (half-life, γ energy) suitable for easy detection with fixed or mobile systems. (3) the parent half-life must be long enough compared to the daughter half-life in order to permit a notably longer use of the daughter isotope. (4) chemical characteristics of the daughter isotope must allow synthesis of products covering the widest range of scanning problems (particularly related to the cost). (5) the separation procedure must be a) easy to operate; b) with a good decontamination factor; c) with no chemical contaminants arising problems for further syntheses; d) allowing high concentration of the radioactive daughter to be obtained; e) giving a constant yield for the daughter separation. With these considerations in mind possible generators are shown divided into three categories, those already used covering a large fraction of the desired characteristics, those already described which do not show an important development due to the lack of several favorable parameters, and those which could find some development in the future. (UK)

Reactor Fuel Reprocessing

29774 (BNWL-CC-1103) NITRIC ACID DISSOLUTION OF PRTR PuO_2-UO_2 FUELS. Schulz, W. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1 Feb 1967. Contract AT(45-1)-1830. 5p. Dep. NTIS $3.00.

The dissolution behavior of various unirradiated and irradiated PRTR PuO_2-UO_2 fuels in HNO_3 is discussed. The percent of plutonium in such fuels which is soluble in HNO_3 is a function of fuel element fabrication technique as well as of irradiation history. The high energy pneumatic densification process (Nupak) provides an oxide mixture which is more readily converted to a solid solution (soluble in HNO_3) than does the incremental loading technique. However, over 95% of the plutonium in fuel irradiated to 5000 MWd/ton U or higher is soluble in HNO_3 irrespective of fuel fabrication procedure. The significance of these results to plant scale dissolutions of PRTR oxide fuel in terms of reduced dissolver corrosion and critical mass control is commented on. (auth)

29775 (JUL-976-CT) CONTINUOUS DISSOLUTION OF $(Th,U)O_2$ FUEL PARTICLES. Sckuhr, P. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Chemische Technologie). Jul 1973. 93p. (In German). Dep. NTIS (U.S. Sales Only) $7.00.

The development of a continuous process for dissolution of $(Th,U)O_2$ fuel particles from graphite fuel elements of high temperature reactors is described. Several dissolvers and processes were tested in the laboratory with unirradiated particle charges of different dissolution rates. With regard to the planned hot cell operation of the pilot-plant JUPITER, the best procedure is to dissolve the particles continuously in a fixed bed. The dissolver consisted of a tube with a spherical bottom. The particles were fed from the top with a proportioning screw. Thorex reagent (13 M HNO_3; 0.1 M A1 $(NO_3)_3$; 0.05 M HF) was metered by a pump through a central pipe ending just above the bottom of the dissolver and flowed upwards through the particle bed. Tests have demonstrated that the amount of particles in the dissolver at a steady state operation depends linearly on the specific dissolution rate and throughput of the particles. Scale-up experiments have shown that it is possible to obtain a throughput of 90 kg of particles/24 hours with a critically safe dissolver. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 29998, 31810, 32081, and 32115.

29776 (MDC-G-4417) REFRACTORY-ALLOY COMPATIBILITY WITH PLUTONIA-238 AT 1800° AND 2000°C. Watrous, J. D.; Ferguson, W. E. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). Aug 1973. Contract AT(45-1)-2138. 84p. Dep. NTIS $5.45.

Investigation of refractory alloy compatibility with plutonia-238 at 1800° and 2000°C indicated that rhenium exhibited the least attack from plutonia. Variables included in the study were refractory alloy composition (W, W-25Re, Re, Mo, Mo-50Re, and W-30 Mo-30Re), plutonia purity (~1 w/o and 0.23 w/o cationic impurities), plutonia stoichiometry (PuO_2 and $PuO_{1.8}$), temperature, and time (2000°C for 1000 h, 1800°C for 2000 h, and 1800°C for 18,000 and 15,000 h). The test specimens consisted of 0.25-g plutonia pellets in contact with two polished metal discs, all in a thick wall pressure-vessel type container of the same alloy. General solution, intergranular precipitation, oxide precipitation, void formation, and intermetallic compound formation were observed in the different test specimens primarily to depths of less than 10 mils but much deeper for tungsten. Both the alloys and plutonia mass transported within the capsules. Rapid oxygen permeability through the molybdenum alloy containers reduced the capacity of the test to provide information on stoichiometric PuO_2 compatibility but remains valid for substoichiometric PuO_{2-x}. The $PuO_{1.8}$ was less aggressive chemically than PuO_2. The relatively small plutonia volume resulted in minimal effect of plutonia purity. Several effects of test variables prevented development of mathematical expressions for alloy penetration as functions of temperature and time. Although rhenium exhibited the least attack, molybdenum, Mo-50Re, W-30Mo-30Re and W-25Re also appeared to offer adequate containment capabilities to 1800°C particularly for substoichiometric purer plutonia. (auth)

29777 POSSIBLE INSTABILITY IN THE DUCT OF AN MHD GENERATOR. Nedospasov, A.V.; Khait, V.D. High Temp. 10: No. 4, 796-797 (Mar 1973).

The superheating instability is investigated for a steady-state flow of an inviscid, nonheatconducting, electrically conducting medium in a planar rectangular duct of uniform cross section in a constant magnetic field. (CES)

29778 AN INDUCTION-TYPE MAGNETOHYDRODYNAMIC GENERATOR WORKING ON THE COMBUSTION PRODUCTS OF AN ORGANIC FUEL. Zaklyaz'minskii, L.A.; Krylova, L.M. High Temp. 10: No. 4, 772-781 (Mar 1973).

The article gives the scheme of an induction-type magnetohydrodynamic generator, working on the combustion products of an organic fuel, with alternating layers of hot and cold working gases. The hot layers are obtained by the development, in a T layer, of a small perturbation of the electrical conductivity, applied to the steady-state flow of the combustion products at the inlet to the magnetohydrodynamic channel of the generator. It is shown that, in a high-power generator ($N \geq 10^6$ kW), it is possible to obtain high values of the internal efficiency ($\eta_T \simeq 0.6$–0.7) and of the power coefficient ($\alpha \simeq 0.2$–0.5). (auth)

29779 INVESTIGATION OF A DISCHARGE BETWEEN THE MODULES OF A COLD INSULATED WALL. German, V.O.; Zektser, M.P.; Lyubimov, G.A.; Parfenov, B.V. High Temp. 10: No. 4, 782-788 (Mar 1973).

The article gives the results of an experimental investigation of a discharge between cooled modules and of the properties of the intermodule insulation, with application to the conditions of an open-cycle magnetohydrodynamic generator. The temperature of the flow reached ≈2500°C, and the surface temperature of the modules ≈100°C. Insulation made of mica, boron carbonitride, and aluminum oxide was investigated. Data was obtained on the leakage currents and on the breakdown voltages, as well as with respect to the dependence of these quantities on the experimental conditions. A study was made of the characteristics of a discharge between a plasma and a cold electrode (module). The article proposes a theoretical model of the layer near the electrode, which satisfactorily explains the experimental data. Based on the results obtained, the article presents certain generalizations and conclusions with respect to the operation of a module of the insulated wall of a magnetohydrodynamic generator. (auth)

29780 CHARACTERISTICS OF THERMIONIC CONVERTER WITH CESIUM-BARIUM FILLING AT HIGH ANODE TEMPERATURE. Osadchii, V.A.; Piskunkov, A.F.; Szhenov, Y.K. High Temp. 10: No. 4, 664-668 (Mar 1973).

An experimental study is made of thermionic converters filled with a mixture of cesium and barium vapors in a regime close to gaskinetic. The investigations are carried out over a much wider range of electrode temperatures than previously and the anode temperature is optimized. High output powers (≈24 W/cm²) are attained. Some conclusions are drawn concerning the power capabilities of such converters. Theoretical curves of the current–voltage characteristics of the converter are presented and the results of a theoretical calculation of the plasma parameters given. (auth)

Facilities and Equipment

Refer also to abstracts 30334 and 32151.

29781 (CEA-R-4471) PETRUS: α β γ NEUTRON SHIELDED FACILITY FOR THE REPROCESSING OF IRRADIATED TARGETS. Berger, R.; Faudot, G.; Sontag, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Aug 1973. 38p. (In French). Dep. NTIS (U.S. Sales Only) $4.00.

The PETRUS facility is designed for the study and production of transuranic elements and particularly for the aqueous processing of targets irradiated in high neutron flux reactors. The shielding has been calculated to allow the handling of 10 mg ^{252}Cf(3×10^{10}n/s^{-1}) and elements with gamma activity corresponding to 2,200 curies of ^{60}Co (i.e., about 3.8×10^{14} curies of mixed fission products). This seven-cell line is located in the radiochemistry laboratory (building 18) at the Fontenay-aux-Roses Nuclear Research Center. Construction work took place from July 1, 1968 to June 29, 1970. The unit became operational on November 16, 1970. A technical description of the facility is presented. (auth)

29782 (CONF-731101-1) DEVELOPMENT OF A LABORATORY SLUG INJECTION MACHINE FOR FABRICATION OF HTGR FUEL RODS. Cannon, D. D.; Bradley, R. A.; Davis, F. C.; Sease, J. D. (Oak Ridge National Lab., Tenn. (USA)). 1973. 19p. Dep. NTIS $3.00.

A laboratory model of a machine for fabrication of HTGR fuel rods has been developed at Oak Ridge National Laboratory to demonstrate the feasibility of the slug injection process for remote fabrication of fuel rods from recycled fuel. The design for the laboratory slug injection machine is based on the principles employed in automated assembly equipment, and conventional indexing and parts feeding equipment are used. The laboratory machine is completely automated, and it performs the major processing steps of particle dispensing, blending, loading, and fuel rod forming at a fabrication rate of approximately 4000 fuel rods per day. (auth)

29783 (CONF-731101-4) PRODUCTION SLUG INJECTION MACHINE FOR FABRICATION OF HTGR FUEL RODS. Davis, F. C.; Sease, J. D.; Cannon, D. D.; Bradley, R. A. (Oak Ridge National Lab., Tenn. (USA)). 1973. 15p. Dep. NTIS $3.00.

A conceptual design of a production-scale slug injection machine for fabrication of HTGR fuel rods has been developed at Oak Ridge National Laboratory. This production machine employs the slug injection process, which has been demonstrated on a laboratory fuel rod machine. The proposed production machine has a projected fabrication rate of 35,000 to 70,000 fuel rods per day, and it is applicable in both contact processing systems for production of fuel rods from virgin fuel and remotely operated processing systems for production of fuel rods from recycled fuel. (auth)

29784 (RD/B/N-2694) EXTENSION OF THE B.N.L. GAMMA FACILITY DATA PROCESSOR. Russell, R. D.; Stephen, W. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). May 1973. 58p. Dep. NTIS (U. S. Sales Only) $5.00.

A guide is presented to modifications of the data processing system developed for the γ-cell complex at CEGB Berkeley Nuclear Laboratories which updates previous reports of the system and program. Described are new PAL III programs designed to improve synchronization of the on-line program and the two on-line chromatographs, and to allow on-line alteration of certain experimental constants used in the program. The guide is also designed for use with the latter program. (auth)

29785 LOW-COST BACKGROUND REDUCTION MEASURES OUTSIDE GAMMA SPECTROMETRIC FACILITIES FOR THE ASSESSMENT OF INTERNAL CONTAMINATION. Erlenbach, H.R. (Monitoring and Controlling Establishment for Radiological Protection and Nuclear Engineering, Dusseldorf). pp 465-468 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

It is suggested that the performance of a clinical gamma spectrometric facility such as a scintiscanner might be considerably improved if it is installed in or transferred to a sand-embedded cubicle that could be set up in a spacious basement room and may be mounted using wooden partitions if the cost is to be minimized. It is emphasized that such "low-level scintiscanners" might constitute the basis of a closely meshed national internal contamination surveillance system. Reference is made to the author's recent study of moderate-cost shielding improvements and a few additional experimental data of pure dolomite sand shielding are given. (auth)

29786 AIR FILTER FOR A HOT CELL. Technical Note N.786. Luxemburg; Commission of the European Communities ([nd]). 4p. (In Several Languages).

An air filter for a hot cell ventilation duct is described which can be replaced using only axial movements. During the replacement, the connection between the hot cell and external air is automatically blocked. A cross section of the filter is presented and described. Details are given by the French patent description No. 1.559.206, by the German public report No. 1.607.703, and by the British patent No. 1.196.361. (HBG)

29787 EXPERIMENTALLY DETERMINED SHAPE FACTORS FOR DEEP PART-THROUGH CRACKS IN A THICK-WALLED PRESSURE VESSEL. Derby, R. W. (Oak Ridge National Lab., TN). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 536, 482-491(1973).

Fracture mechanics shape factors for deep, part-through cracks in thick-walled epoxy pressure vessel were determined experimentally and compared with three theoretical estimates. The agreement was especially good for cracks of depth approximately equal to half the wall thickness. The fracture toughness, K_{Ic}, of the epoxy was measured with ½-in. square beams loaded in four-point bending and was found to be 929 psi $\sqrt{in.}$ (auth)

29788 ANALYTICAL APPLICATIONS OF THE J-INTEGRAL. Merkle, J. G. (Oak Ridge National Lab., TN). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 536, 264-280(1973).

It has recently been shown by experiment that a quantity known as the J-integral may be a useful fracture criterion in the inelastic range. The mathematical definition of the J-integral is first used here, in combination with some simplifying assumptions, to derive the known relationship between the conventional elastic stress concentration factor of a sharp notch and the elastic stress intensity factor for a crack of the same shape. The same assumptions, together with a generalization of Neuber's equation for the inelastic stress and strain concentration factors for a sharp notch, are then used to derive a relationship between the J-Integral and the parameter K_{Icd} of the Equivalent Energy Method. The purpose of this derivation is to identify a set of assumptions which, in combination, lead to an explicit relationship between the two parameters. A graphical procedure for estimating upper and lower bounds on the full restraint value of the fracture toughness is also discussed. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 32136, 32139, and 32177–32179.

29789 (CLM-R-123) THERMAL CONVECTION DRIVEN BY INTERNAL HEAT SOURCES: AN ANNOTATED BIBLIOGRAPHY. Peckover, R. S.; Hutchinson, I. H. (UKAEA Research Group, Abingdon. Culham Lab.). 16 Mar 1973. 30p. Dep. NTIS (U.S. Sales Only) $3.50. UK 50 pence.

A bibliography of 43 papers on thermal convection driven at least partially by internal heat sources is presented. The commentary is partly an indication of the contents of each paper, and is partly an expression of personal opinion. The papers are divided into the following sections: classical works on convection; Rumford convection in horizontal layers; Rumford convection in spheres and spherical shells; Rumford convection in vertical tubes; applications in geophysics and meteorology; and turbulent convection. (auth)

29790 CONDENSING HEAT TRANSFER IN STEAM–WATER CONDENSING-INJECTOR. Miyazaki, K.; Nakajima, I.; Fujii-e, Y.; Suita, T. (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 411-418(Jul 1973).

An experiment on the direct heat transfer process between supersonic steam and a subcooled water jet was performed, using a steam-water condensing-injector. Photographic observation provided information on the state of flow, and establishment of a critical separate steam-water flow was confirmed. The temperature and pressure distributions along the flow were measured and the effective coefficients of condensing heat transfer were evaluated from the observed data, based on a model embodying an idealized interface between vapor and liquid. In the vicinity of the water nozzle exit, where the vapor-liquid interface was distinct, the heat transfer coefficients obtained were from 14 to 28 (cal/°C/cm²/sec), and some correlation was observed among Nusselt, Reynolds, and Jakob numbers, upon adopting the velocity and the physical properties of the steam phase. The relations $Nu = 6.0 \cdot Re^{0.8}$ (Pr = 1.04 to 1.10), and $Re = 1.8 \times 10^{8} \cdot Ja^{3.0}$, i.e., $Nu = 1.6 \times 10^{8} \cdot Ja^{2.7}$ were derived as a rough estimation. No clear correlation could be discerned in the corresponding data obtained from observation points further downstream, where a distinct steam-water interface no longer existed. In conclusion, it is proposed that, in deriving the correlations between Nu and Re or Ja, the physical properties of the vapor and the vapor-liquid relative velocity should be adopted, on account of the strong dependence of condensing heat transfer on steam velocity and water subcooling. (auth)

29791 PRECESSION DAMPING OF SOLAR PROBES BY RERADIATIVE FORCES. Choong, P. T.; Mason, E. A. (Massachusetts Inst. of Tech., Cambridge). Nucl. Technol.; 19: No. 3, 165-173 (Sep 1973).

Thermal analysis of the temperature distribution around a spinning shell under solar radiation indicated that the resultant asymmetric temperature distribution is capable of generating sufficient thermal reradiative force to stabilize small solar probes. The steady-state normal component of this force at optimum spin is barely adequate to damp out the precession of a small solar probe. This study showed that, by coating the shell surface with a radioisotopic heat source, the useful thermal reradiative force is only increased moderately. However, the optimum spin can be shifted upward by an order of magnitude to a spin range where the attitude of the spacecraft is relatively insensitive to small disturbances. By coating the shell surface with the subliming material, the sublimation force acting on the shell is increased enormously. The numerical techniques developed to solve the inherently two-dimensional transient heat flow equation having nonlinear boundary conditions appeared to be numerically stable. (auth)

29792 HEAT-TRANSFER CRISIS IN BOILING OF LIQUID METALS AND NONMETALLIC LIQUIDS IN FREE-CONVECTION CONDITIONS. Dobrotvortsev, V.V. High Temp. 10: No. 4, 744-748 (Mar 1973).

The heat-transfer crisis in the boiling of liquids in natural-convection conditions is discussed. It is assumed that the onset of the crisis depends on the ratio of the rate of evaporation of the liquid microlayer under the vapor bubbles to the rate of removal of vapor from the heating surface. It is shown that the critical heat fluxes are significantly affected by the molecular thermal conductivity of the liquid phase and molar heat and mass transfer. Experimental data for the critical heat fluxes for the liquid metals and nonmetallic liquids in the pressure range 0.0068 to 205 kg/cm² are correlated. (auth)

29793 NOTE ON UNIQUENESS IN THE LINEAR THEORY OF HEAT CONDUCTION WITH FINITE WAVE SPEEDS. Nunziato, J. W. (Sandia Labs., Albuquerque, NM). SIAM (Soc. Ind. Appl. Math.) J. Appl. Math.; 25: No. 1, 1-4(Jul 1973). (SC-DC-71-4345).

In this note, a uniqueness theorem for the generalized linear heat equation is established for finite domains. The proof of the theorem rests on two lemmas which are counterparts of known results in the dynamical theory of linear viscoelasticity. (auth)

Materials Testing

Refer also to abstracts 30561, 30755, and 32150.

29794 (JAERI-M-5265) DETECTION OF RUPTURED FUEL PARTICLES IN THE FUEL COMPACT BY ACID LEACH TECHNIQUES. Tobita, T.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokyo). May 1973. 19p. (In Japanese). NTIS (U.S. Sales Only).

Three techniques for determining failed particles in the HTGR fuel compact were studied: (1) nitric-acid leaching, (2) oxidation and acid leaching, and (3) electrolytic disintegration and acid leaching. The nitric-acid leaching is not suitable since the acid does not penetrate into the matrix; the oxidation and nitric acid leaching is also difficult for application because the SiC layer of fuel particles is destroyed slowly by the oxidation. The electrolytic disintegration, on the other hand, is feasible, because the compact is disintegrated stepwise on the cathodic side of the compact in nitric acid without damage to the coatings of fuel particles. The failed particle fraction is obtainable by analyzing the leached amount of U. (auth)

29795 (KFK-1841) NEUTRON RADIOGRAPHY AT FR2. Schuelken, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Abt. Reaktorbetrieb und Technik). Sep 1973. 110p. (In German). Dep. NTIS (U.S. Sales Only) $7.50.

A neutron radiography device for nondestructive testing of highly radioactive reactor components will be built at FR2. The results of initial test measurements are reported. They give some useful information for the final construction and show the difference between neutron-, x- and betatron-radiographs. The transfer exposure method with dysprosium, gold, and indium in connection with Structurix- and Osray-films was used for all measurements. Nomographs were made, which are generally valid for thermal neutron radiography facilities. (GE)

29796 INVESTIGATION OF RADIATION DOSE RATES AROUND GAMMA RADIOGRAPHY EXPOSURE CONTAINERS DURING USE. Atherton, N. J. (Dept. of Employment, London). Brit. J. Non-Destruct. Test.; 15: No. 5, 143-145(Sep 1973).

Radiation dose rate measurements were made around six types of γ radiography exposure containers set up as for radiography of a pipeline weld. These experiments were carried out as part of an investigation of the radiation doses received by radiographers in the course of their work. There were wide variations of dose rate around each container, and between different containers. In general, shutter type containers provided more effective attenuation of the radiation than did the manual extraction types. (auth)

29797 RADIOGRAPHERS EXPOSED TO EXCESSIVE RADIATION. Brit. J. Non-Destruct. Test.; 15: No. 5, 152-154(Sep 1973).

Four examples are described and discussed of workers receiving excessive radiation. Suitable safety precautions which would have prevented the accidents are suggested. In the first instance a radiographic source used on a construction site did not retract from its working position into its shielded position when remotely operated by the radiographers. In the second case the radiographer used a shielded source designed for making one exposure at a time by operation of a shutter, as a panoramic source out of its shielding. Third, a man received an excessive dose and a severe fright when an industrial x-ray machine was energized without warning while he was in a position of danger. In the last case a scrapyard worker received an excessive dose of radiation when cutting up what he thought was a piece of scrap metal pipe. (UK)

29798 PHOTOMETRIC MEASUREMENTS OF GRAIN DENSITY IN AUTORADIOGRAPHS. Rogers, A. W. (Medical Research Council, Oxford). J. Microscopy; 96: No. 2, 141-153 (Oct 1972).

A technique is described for measuring the grain densities in areas of emulsion from 10 to 200 μm^2, using vertical incident illumination which converts the silver grains into bright specks on a black background. The light reflected by the silver grains in the measuring area is integrated with a photometer to give a reading that is directly proportional to the number of grains present over a wide range of densities. Speeds of 200 counts/h can be maintained on suitable material throughout a working day without loss of accuracy. The characteristics of the method, the selection of equipment, and some sources of artefacts are discussed. (auth)

29799 PROTON-SCATTERING RADIOGRAPHY. West, D.; Sherwood, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). Non-Destruct. Test. (Guildford, Engl.); 6: No. 5, 249-257(Oct 1973).

Small-angle multiple scattering of high-energy protons has recently been shown to give rise to an edge pattern which can be used for radiography. The intensity pattern involved is derived and its implications for radiography discussed. The degradation of the intensity pattern by obscuring matter and various instrumental effects is derived and used in the design of arrangements for taking scattering radiographs with protons of 160 MeV and 7,100 MeV. Sample radiographs illustrate the main differences from, and advantages of the technique over, x-radiography recorded on film. The resemblance to xero-radiography is pointed out. (auth)

29800 STUDIES WITH GAMMA OR X RADIATION. Technical Note N.845. Luxemburg; Commission of the European Communities ([nd]) . 4p. (In Several Languages).

A device was developed for the nondestructive testing of objects emitting gamma or x radiation, for example, irradiated fuel elements. The device consists of a cylindrical container with two adjustable drums. One drum contains filters for the intensity control of the gamma or x-ray flux of low energy. The second drum contains screens reducing the gamma flux to acceptable levels for the measuring device. Because of its compact design, the device can be inserted as one unit into one of the already available channels in the wall of hot cells. Details are given in the French patent No. 1.537.438. (tr-auth)

29801 TRACK-ETCH RADIOGRAPHY: ALPHA, PROTON, AND NEUTRON. Berger, H. (Argonne National Lab., IL). Nucl. Technol.; 19: No. 3, 188-198(Sep 1973).

Several polycarbonate plastics and cellulose nitrate have been studied for radiographic imaging studies with alpha particles, protons, fast neutrons, and thermal neutrons. Comparisons, made with conventional film-detection methods in terms of exposure requirements, spatial resolution, contrast, and convenience, show that track-etch techniques can give comparable or better results. Comprehensive results for thermal-neutron radiography indicate that total thermal-neutron exposures in the range of 2×10^7 to 4×10^8 n/cm^2 provide radiographs which display a contrast sensitivity of 1 to 3% and a spatial resolution of ~25 μm. A scattered-light enlargement technique provides a simple means to improve visual contrast of track-etch images. (auth)

Nuclear Explosions

Refer also to abstracts 29848, 29849, 29852–29855, 29912, and 32198.

29802 (AD-759274) RANDOM MODEL FOR HALF-AMPLITUDE DECAY TIMES OF RAYLEIGH WAVES EXTENDED ARRAY EVALUATION PROGRAM. Special Report, 1 April 1972–31 March 1973. Alsup, S. A.; Lambert, D. G. (Texas Instruments Inc., Dallas). 25 Jan 1973. Contract F33657-72-C-0725. 41p. (TI-SR-4). NTIS.

An approach to prediction of long-period Rayleigh wave signal persistence is taken through "mean-time-between-failure" and "waiting time" stochastic models. The estimate applies only to the generalized case of a network of recording stations and wide spatial distribution of earthquake sources. Rayleigh waves from Eurasian earthquakes recorded on Very Long Period Experiment systems were analyzed to obtain data for the study. Successive time intervals between the maximum recorded amplitude, A, and the latest point of recorded signal equal to A/2, the time between A/2 and A/4, A/4, and A/8, etc. were measured until the signal amplitude reached the ambient noise level. Resulting "half-amplitude decay times" (Wn) were found to follow a gamma probability law. The distribution of observed Wn fits this law with 0.90 confidence or greater according to the Chi-squared criterion. The results indicate that the probability distribution of half-amplitude decay times in earthquake Rayleigh waves can be readily estimated using appropriate gamma distribution parameters. (auth)

29803 (NVO-136) RULISON: SITE CLEANUP REPORT. (USAEC Nevada Operations Office, Las Vegas). Sep 1973. 68p. (PNE-R-64). Dep. NTIS $5.50.

Details regarding the cleanup operations as well as a brief description of the present standby status of the Rulison site are presented. Currently, there are no plans for the decommissioning and final cleanup of the site, inasmuch as possible sale of the gas to residential, commercial, and industrial users is now being considered by the sponsor. Cleanup work at the site commenced on July 10, 1972, and was completed July 25, 1972. The purpose was to remove from the site all equipment and materials not needed for possible future gas production. This was accomplished, and the radiological condition of the site was documented. (TFD)

29804 FLAX TV SYSTEM (25 AUG 1972) (ENGINEERING MATERIALS). (Sandia Labs., Albuquerque, N. Mex.). (CAPE-2363).

46 drawings.

An experimental TV system was installed downhole on Project FLAX. The fact that the video system survived zero time is significant. (auth)

29805 GRAPHICS DISPLAY SYSTEM. Berndt, C. W. (To United States Atomic Energy Commission). US Patent 3,736,411. 29 May 1973. Filed date 17 May 1971. 70p.

A system for computing and displaying prompt and delayed effects of nuclear explosions with respect to a geographical area is described. The display is based on various input parameters concerning the initial conditions under which an explosive is detonated. The display is a superposition of prompt effects, viz., blast, thermal effects, etc., represented by concentric circles; fallout, represented by a time varying growing and variegated mosaic pattern; and a map whose scale is controllable upon command, this being accomplished by three separate images simultaneously projected on a screen from three separate sources. A computer controls the display and makes changes on it, utilizing relationships which characterize nuclear effects as functions of time. The apparatus is useful for understanding, analyzing, demonstrating and predicting the effects of nuclear weapons. (Official Gazette)

29806 NEVADA AUTOMATED DIAGNOSTICS (NAD) SYSTEM (12 Feb 1970) (ENGINEERING MATERIALS). (California Univ., Livermore. Lawrence Livermore Lab.). (CAPE-2364).
1 drawing.

29807 NITROGEN OXIDES, NUCLEAR WEAPON TESTING, CONCORDE, AND STRATOSPHERIC OZONE. Goldsmith, P.; Tuck, A. F.; Foot, J. S.; Simmons, E. L.; Newson, R. L. (Meteorological Office, Bracknell, Eng.). Nature (London); 244: No. 5418, 545-551(31 Aug 1973).
It is stated that although amounts of nitrogen oxides equivalent to the output from many Concordes were released into the atmosphere when nuclear testing was at its peak, the amount of ozone in the atmosphere was not affected. (auth)

29808 T PHASE RADIATION FROM THE CANNIKIN EXPLOSION. Northrop, J. (Naval Undersea Center, San Diego, California, 92132). J. Geophys. Res. 78: No. 11, 1809-1817 (10 Apr 1973).
The T phases from both the 5-MT Cannikin underground explosion and the subsequent crater collapse were recorded on sofar hydrophones of the Pacific Missile Range at distances up to 3500 km. The T phase signals were similar to those from naturally occurring earthquakes in the Aleutians, except that the onset was more rapid and the main arrival was followed by numerous reverberations from submarine topography. No T phases from aftershocks that might have been triggered by the Cannikin shot were observed up to 36 hours afterwards. (auth)

29809 EFFECTIVE SPECIFIC IMPULSE OF EXTERNAL NUCLEAR PULSE PROPULSION SYSTEMS. Reynolds, T. W. (Lewis Research Center, Cleveland). J. Spacecraft Rockets; 10: No. 10, 629-630(Oct 1973).
The original concept of using externally exploded nuclear pulse units to propel a space vehicle involved the use of fission energy sources. The minimum size energy package was large (of the order of 4.18×10^{12} joules or 1000-tons TNT equivalent). Renewed interest in this mode of propulsion has been stimulated by the possibility of using small fusion microbombs as the energy source. The fusion reaction might be initiated in small pellets of fusable material by either an intense laser beam or an intense relativistic electron beam. These schemes are of particular interest because of the stated possibility of achieving high thrust-weight ratios at high effective specific impulse values, of the order of 10,000 sec. A pulse unit containing fusionable material plus propellant mass is ejected into position behind the vehicle and the pulse energy triggered. The propellant mass expands. A fraction of the propellant intercepts the pusher plate of the vehicle and transfers momentum and heat to the vehicle. The heat flux causes some ablation of the pusher surface. A succession of such pulses is continued until the desired total impulse for the mission is obtained. The effective specific impulse for such a system can be expressed as $(I_{sp})_{eff} = f_c \cdot f_m \cdot (I_{sp})_{base}$. One must evaluate the mean propellant velocity $\bar{v}$ that the system can tolerate $(I_{sp})_{base}$, the effectiveness with which the mass of the pulse can be collimated so as to intercept the pusher plate of the vehicle (f_c), and the unavoidable mass losses in the system (f_m). The model used for analysis is similar to the previous Orion studies but has been generalized and simplified to permit ready evaluation of the interrelation between pulse size, vehicle size, specific impulse, pulse separation distance, and collimation. (auth)

Protective Structures and Equipment

Refer also to abstract 29797.

29810 PERSONNEL SAFETY FEATURE STANDARDS FOR INDUSTRIAL RADIATION FACILITIES. West, C. M.; Roberts, E. Jr.; Jones, D. A. (Union Carbide Corp., Oak Ridge, TN). Health Phys.; 25: No. 5, 481-487(Nov 1973).
The Oak Ridge Y-12 Plant is a research and production installation operated by Union Carbide Corporation-Nuclear Division for the USAEC. The nature and versatility of this work require the use of x-ray and radiographic sources for nondestructive testing and material analyses. Presently, there are over 110 x-ray generators or source units in the plant. These devices range from units which have a radiation output at 1 m of a few mrem/hr to one which generates over 2000 rem/min at an energy of 12 MeV. In order to facilitate decisions as to the appropriate radiation safety features to be installed on future facilities and for upgrading present units, engineering standards were developed by representatives from operations, maintenance, engineering and radiation safety groups. A matrix (10 types of facilities vs 30 personnel safety features) was developed to help maintain assurance that all important safety features are considered and applied with consistency according to type and use of a particular facility. The standards themselves encourage consistency in equipment specifications and/or design of the individual safety features in accordance with high standards of quality and performance. Consequently, the use of such standards serves to improve the level of radiation safety protection at industrial radiation facilities. (auth)

Safety Engineering

Refer also to abstracts 29810 and 30117.

29811 (UCRL-50007-73-1) HAZARDS CONTROL PROGRESS REPORT NO. 45, JANUARY-APRIL 1973. (California Univ., Livermore. Lawrence Livermore Lab.). 1 Jun 1973. Contract W-7405-eng-48. 27p. Dep. NTIS $4.00.
Progress is reported on the following: calculation of respirator cartridge service life-tests with seven classes of solvent vapors; performance characteristics of three types of heat actuated detectors as tested in LLL Experimental Duct System, fusible rods, fusible plugs, and sprinkler heads with fusible links; AEPA filter fire protection-smoke plugging problems; progress in multisphere neutron spectrometry; and GAMANAL, none available for gamma ray spectra analysis. The computer code GAMANAL has been adapted for execution on the CDC-7600 computers. The adapted version has been compiled and stored on tape for access by hazards control users. (TFD)

Vacuum Engineering

29812 ULTRA-HIGH-VACUUM HEATED INSTALLATION. Palatnik, L. S.; Fedorenko, A. I.; Lebedeva, M. V.; Usenko, M. Yu. (Kharkov Polytechnic Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 521-522(1973).
Translated from Prib. Tekh. Eksp.; 16: No. 2, 161-162(1973).
An all-metal ultra-high-vacuum installation designed for obtaining a limiting vacuum of $\sim 10^{-10}$ torr is described. The installation is designed for the condensation of thin films by the thermal method, but it may also be used for other research requiring an "oil-free" ultrahigh vacuum. The work-volume ≈15 liters and is evacuated down to $\sim 10^{-9}$ torr in 6 to 7 h as a result of the alternate action of three zeolite preliminary-evacuation pumps and an "Orbitron" ion-sorption pump. The temperature of the degassing annealing process is 300°C. (auth)

29813 ADSORPTION OF HYDROGEN, CARBON MONOXIDE, AND OXYGEN ON VACUUM DEGASSED STAINLESS STEEL 304 AT 20°C. Horgan, A.M.; Dalins, I. (Space Sciences Laboratory, NASA, Marshall Space Flight Center, Huntsville, Alabama 35812). J. Vac. Sci. Technol. 10: No. 4, 559-561 (July 1973).
A detailed study of the adsorption of oxygen, hydrogen, and carbon monoxide on Type 304 stainless steel at 20°C is presented. The original molecular beam assembly used conventional titanium sublimation (getter) pumps in the chamber containing the final collimating aperture. This equipment was modified by replacing the getter pumps with a differential ion pump (100 l/s). A brief outline of the calibration procedure for the molecular beam is given. It was found that hydrogen is not adsorbed on vacuum degassed and baked Type 304 stainless steel at pressures $\leq 10^{-6}$ torr. Carbon monoxide does adsorb to a small extent on this material at 20°C. Oxygen undergoes rapid and efficient adsorption on Type 304 stainless steel at 20°C. (RCK)

29814 A MULTIPLE SAMPLE HOLDER FOR USE IN ULTRAHIGH VACUUM. Davis, L.E.; Bryson, C.E. III; Melles, J.J.; Henson, J.E.; Levenson, L.L. (Department of Physics and Graduate Center for Materials Research, University of Missouri-Rolla, Rolla, Missouri 65401). J. Vac. Sci. Technol. 10: No. 4, 564-565 (July 1973).
A sample carrier that allows the preparation and study of twenty wafers at several positions in a stainless steel bell jar is described. The sample carrier is of simple construction, versatile, and permits the rapid handling of samples. With this equipment it is possible to carry out multiple evaporations and obtain surface analysis of twenty samples without dismantling the vacuum system. This equipment is highly versatile for the preparation and characterization of surfaces in ultrahigh vacuum. (RCK)

29815 ULTRAHIGH VACUUM AIRLOCK FOR LEED AND AUGER SPECTROSCOPY. Ono, M.; Shimizu, H.; Nakayama, K. (Electrotechnical Laboratory, Tanashi, Tokyo, Japan). J. Vac. Sci. Technol. 10: No. 4, 566-567 (July 1973).
An airlock was designed and fabricated for connecting a conventional LEED—Auger electron spectroscopy (AES) chamber and a sample manipulator with a long linear stroke. The device can be used as a room for sample treatments such as heating, ion

bombardment, or gas reaction on the same surfaces with destructive effects upon neither the analyzer nor the pumping system. The device consists of a short pipe connecting two conflat flanges, 200 mm in diam, and a sump-shaped bottom with a separation valve, which is composed of a valve disk, a pushing lever, and an opening 38 mm in diam at the center of the sump. A linear motion feedthrough attached to a horizontal tube on the side wall of the pipe pushes the lever with U-shaped end that presses the flat surface of the sump with the disk having a viton O-ring. Lifting of this end is necessary for movement of the disk which is rotated around the vertical shaft driven by a rotation feedthrough through a bevel gear made from copper alloy. (RCK)

29816 MODULATION OF THE DESORBED ION CURRENT IN BAYARD-ALPERT GAUGES. Pittaway, L.G. (Mullard Research Laboratories, Redhill, Surrey, England). J. Vac. Sci. Technol. 10: No. 4, 507-512 (July 1973).

The modulation characteristics of a Bayard-Alpert gauge have been investigated in the presence of a large residual current of desorbed ions, following exposure of the gauge to oxygen. Having observed an increase in the collector current on modulation, when the gas phase ion current was relatively small, modulation factors were measured for the desorbed ion current and were found to vary in magnitude up to 0.2. A sharp peak, which increased the amplitude of the mean residual current by approximately 30%, was also found in the modulation curve between V_{mg}=-10 and -35 V. Computed potential distributions and ion trajectories have shown that this peak can be attributed to the focussing action of the electrostatic field on energetic ions desorbed from the modulator. Experimental verification of this hypothesis was obtained by selective cleaning of the grid and modulator using electron bombardment. The presence of such a peak would produce errors in the proposed alternative modes of modulation in which a modulator-to-grid potential of -20 V is used. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 29663, 29905, 29909, 30471, 30477, and 30478.

29817 URANIUM AMONGST THE FOSSILS. von Backstroem, J. W. (Atomic Energy Board, Pelindaba, S. Afr.). Nucl. Active; 31-34(Jul 1973).

The intimate relationship that exists between the occurrence of gold and uranium in the sediments of the Witwatersrand Supergroup is almost without geological parallel. The two were deposited together as an integral part of sediments transported by water. Still more unusual bedfellows are the reptiles, fish, and flora fossils with which uranium has recently been found embedded in line, clastic sediments in the Karoo basin. This geological formation has been likened to that of the Colorado Plateau, USA, whose uranium deposits are being commercially exploited. An aerial radiometric survey of the Karoo deposits will be undertaken and the processed results made public. (auth)

29818 PHYSICO-CHEMICAL CONDITIONS OF MOLYBDENITE FORMATION IN HYDROTHERMAL URANO-MOLYBDENIC DEPOSITS. Tugarinov, A. I.; Khodakovskii, I. L.; Zhidikova, A. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 7, 975-984(Jul 1973). (In Russian).

An estimation of the physico-chemical conditions characteristic of hydrothermal solutions forming urano-molybdenic deposits is given. Conditions of Mo(VI) transportation by hydrothermal solutions in the form of fluoride, thiomolybdate, and urano-molybdenic complex compounds are considered. The possibility of simultaneous Mo and U transportation in hydrothermal solutions in the form of hexavalent compounds in the presence of low hydrogen sulfide concentrations ($\sim 10^{-1}$ mole/l) at temperatures $\approx$150° and simultaneous molybdenite and pitchblende crystallization during their reduction to the tetravalent state was established. (auth)

29819 ACCESSORY AUTUNITE AND URANIUM HYDROXIDES IN PEGMATITES FROM THE WESTERN PART OF THE UKRAINIAN SHIELD. Litovchenko, K. I.; Kuts, V. P. Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 8, 704-706(Aug 1973). (In Ukrainian).

Some accessory uranium-containing minerals, such as autonite and uranium hydroxides, that are similar to becquerelite and curite by their properties are found in the rare metal pegmatites from the South-western part of the Ukrainian Shield. They are hypergenic and substitute the accessory uranium and uranium-containing minerals. (auth)

29820 DISTRIBUTION OF URANIUM IN REEFS OF THE RED JASPEROUS QUARTZ OCCURRING IN SCARNS AND HORNFELS. Nozhkin, A. D. Geol. Geofiz.; No. 7, 128-130(Jul 1972). (In Russian).

The vein mineralization of uraniferous jasperous quartz, coated on scarn and hornfel limestones of the contact aureole of one of the pre-Cambrian granite massifs, is described. The erratic character of the distribution of uranium in the veins of jasperous quartz, caused by the effect of the lithologic composition of the containing rocks, and also by the appearance of recrystallization of the silicon and iron hydroxide, was indicated. The increased concentration of the uranium in veins was established in regions of intersection or amphibol hedenbergite–andradite scarns and bituminous marble rocks containing components (Fe^{2+} and organic materials) essentially reducing the oxidation-reduction potential of uranium solutions. (tr-auth)

29821 SISTEMA RAZRABOTKI MESTOROZHDENII URANOYKH RUD. (Methods of Mining Uranium Deposits). Chesnokov, N.; Petrosov, A. A. Moscow; Atomizdat (1972). 344p. (In Russian).

An experiment on the mining of very deep uranium deposits in Europe, the depth of the mining exceeding 1500 m, is described. It is shown that to the degree of the increase of the depth of the mine the role of mining systems with bracing and backing increased. In the mining of strong ore zones and sections of complex vein intersection mining systems with bracing of the walls and frame timbering with hardened backing was used. The concentration of commercial mineralization in some limited sections of the ore vein determined the use of methods of selective removal for uranium ores in sections of the vein. Considering the localization characteristics of the mineral in the vein boundaries, variants of the mining system with parameters most nearly answering the conditions of minimum inclusion in the mining of non-productive sections were used. In practice cleaning blocks in the form of trapezoids, parallelograms, and triangles were dispersed. A significant part of the book was devoted to the technology of the clean removal. Technical economic indicators and recommendations on contemporary mining systems and the technology of extraction with increased depth of the mines are discussed. (tr-auth)

29822 RADIOACTIVE PSEUDOMALACHITE FROM URGEIRICA, PORTUGAL. De Camargo, W. G. R.; De Madureira Filho, J. B. (Univ., Sao Paulo, Brazil). An. Acad. Brasil. Cienc.; 44: No. 3-4, 451-454(1972). (In Portuguese).

Crystals of radioactive pseudomalachite were identified in samples from Urgeiriça, the well-known uranium deposit of Portugal. The crystals are associated into aggregates of fibrous radiating and colloform structures, having concentric bands of various shades, from light to dark green. The crystals may be morphologically described as elongated and thin prisms of monoclinic symmetry, limited by non-indexed faces of the crystal forms (h0l) and (0Kl) or (hkl). Under the polarizing microscope, the crystals are transparent and light green in color, show weak pleochroism and are biaxial (-). The refraction indices were measured by the immersion method and 2V determined in the universal stage. Optical constants are, together with the corresponding orientations: $X = \alpha = 1.772$; $Y = \beta = 1.790$ (calc); $b = Z = \gamma = 1.796$; $2V = 42°$; $X \wedge c = 40°$; $\gamma - \alpha = 0.024$. The x-ray diffraction powder photographs, obtained with CuKα radiation in 114.6 mm powder cameras, exhibit the given main reflections (in A), together with the corresponding intensities, visually estimated: 4.50 (10)–2.39 (9)–3.47 (8)–2.33 (7)–2.43 (6)–2.24 (6)–1.73 (6)– 2.99 (5)–2.73 (5)–1.77 (5)–3.12 (4)–3.06 (4). Autoradiography photographs detected weak radioactivity of the samples, presumably in connection to small uranium content in the pseudomalachite crystals, as impurity. Semiquantitative x-ray fluorescence analysis revealed some hundreds ppM, both for U and As. Pseudomalachite is a secondary mineral, which occurs in Urgeiriça, in association with several uranium minerals of secondary origin, such as autunite, meta-autunite, torbernite, and phosphuranylite. The mineral has been presumably formed by interaction of solutions derived by alteration process of phosphates, (apatite) and copper minerals (chalcopyrite). (auth)

29823 MINERAL AND TEMPERATURE STAGES IN A PRECAMBRIAN URANIUM DEPOSIT. Makivchuk, O. V.; Koval, V. B.; Babenko, O. V.; Gnatenko, G. I. Geol. Zh. (Russ. Ed.); 32: No. 3, 105-109(Mar 1972). (In Russian).

The granites and albitites of the deposits located in the deep laid fracture zone extending in the submeridian direction along the coarse anticlinal structures and controlling the body of uranium-bearing sodium metasomatites were studied. The ore bodies are adapted to the albitites and in rare cases to the albitite-microcline rocks. For study of the temperature stages of the mineral formations in the deposits the temperatures of homogenization of the gas-liquid inclusions in the minerals of granites and albitites were used. In the granites the inclusions were established in quartz and microclines and in albitites in all generations of the albitites, quartz, and carbonates. The primary-secondary two-phase gas-liquid inclusions were subjected to detailed investigation. It was established that the formation of the granites in the deposit was represented by the metasomatic and passed through two stages. In the first stage (425 to 570°C) quartz, oligoclase, and albite-oligoclase were crystallized; mineral-forming solutions were gaseous fluids. In the second stage (310 to 390°C) the temperature, pressure, composition, and density of the solution were changed; they became water-salt solutions with variable quantities of carbon dioxide; development of the microcline along the plagioclase appeared. The albitites were formed in three stages. In the first stage (202 to 280°C) albite I, aegirine, alkali amphiboles, sphene, and carbonate I were formed. The basic mass of the uranium minerals was deposited at the end of the first stage at temperatures of 210 to 220°C; in the second stage (140 to 180°) albite II, and quartz II (quartzification) were formed; in the third stage (120 to 140°C) albite III, and quartz III were formed. It was assumed that in the second and third stages partial dissolution and redistribution of the ore mineralization occurred. (tr-auth)

29824 RADIOELEMENT DISTRIBUTION IN THE BASEMENT COMPLEX OF THE YUKON–TANANA UPLAND, Eielson Deep Test Hole, Alaska. Bunker, C. M.; Bush, C. A.; Forbes, R. B. J. Res. U. S. Geol. Surv.; 1: No. 6, 659-663(1973).

Uranium, thorium, and potassium contents were determined in 94 samples of drill cuttings from a 9,774-foot-deep exploratory hole drilled entirely in crystalline schists of the basement complex of the Yukon–Tanana Upland. The data indicate two distinctively different rock types and reflect differences in the calcite content of the rock. Zones of anomalously high concentrations

of the radioelements probably reflect the effects of the emplacement of the nearby Eielson pluton. (auth)

29825 NATURAL RADIOACTIVITY OF SOME BLACK-EARTHS IN THE EUROPEAN AREAS OF THE USSR. Yastrebov, M. T. Vestn. Mosk. Univ., Biol. Pochvoved.; 26: No. 5, 93-97(1971). (In Russian).

The radionuclides ^{238}U, ^{226}Ra, ^{232}Th, and ^{40}K in black earth were determined by gamma spectrometry, with a maximum error of 11%. The order of absorption of these heavy nuclides by plant roots is $^{226}Ra > ^{238}U > ^{232}Th$. In the southern chernozems the ^{238}U content in the humus-accumulating layers was a factor of 1.3 to 1.8 lower than in rock because of the loss of this isotope by being taken up in plant roots. The ^{226}Ra, ^{232}Th, and ^{40}K contents of the southern chernozem layer is 1.3 to 1.5 times that in rock, apparently because of less intense removal by plants. In distinction from the leached soils, the ^{238}U accumulation in carbonate illuvial layers of the southern chernozems is small. Analytical data are tabulated. (TTT)

29826 FUNNEL OF INCREDIBLE WEALTH. Newby-Fraser, A. R. Nucl. Active; 5-9(Jul 1973).

The history and operation of the Palabora Mining Company in the Eastern Transvaal, South Africa are described with particular reference to the Palabora Complex, a geologic deposit which contains enormous amounts of copper, magnetite, zirconium, thorium, and uranium. The copper and uranium mining operations and the chemical processing of low-grade U ores to produce cleanly separated high-grade U_3O_8 are discussed in detail. (LCL)

29827 SPECTRAL GAMMA LOGGING OF RADON-BEARING WELLS. Guzeva, R. V.; Doshechkin, V. P.; Los'ev, M. I.; Matveev, M. G.; Fedorin, V. V. Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 5, 100-107(May 1972). (In Russian).

The use of spectral γ logging is based on the difference of the γ emission of uranium ores and the decay products of radon occurring in holes and, under appropriate conditions, spectral γ logging can guarantee the reliable determination of concentration of uranium in the ore. These conditions include the accurate selection of the energy interval and use on rocks in which the γ radiation of the ores can be isolated from the total γ radiation. The best combination for measurement with the spectrometer used during the present studies is the energy interval from 200 to 250 keV and with rocks having a discrimination of 550 keV. With selection of the optimum energy interval the size of the separation factor and the uranium concentration evaluation errors which are dependent on the instability of the energy scale and other factors were taken into consideration. With an instability of the energy scale of about 3% the evaluation of the uranium concentration with errors up to 10% is guaranteed for Rn/U ratios no greater than 5. The effect of the irregularity of the distribution of uranium on the selection of the energy level of the γ radiation was checked by carrying out spectral γ logging at different energy intervals in deposits with very irregular distribution of uranium in the ore. It was established that in the determined limits the irregularity of the distribution of uranium does not affect the selection of the energy interval. The results of industrial verification of the method of spectral γ logging makes it possible to recommend it for the determination of uranium in dry Wells containing radon. (tr-auth)

29828 TEMPERATURE INVERSION AS A SOURCE OF DISTURBANCE IN A SPECTROMETRIC GAMMA SURVEY. Filimonov, V. V.; Danilov, V. S. Izv. Akad. Nauk SSSR, Fiz. Zemli; No. 4, 110-112(Apr 1972). (In Russian).

Results are presented of observations that made it possible to evaluate quantitatively the magnitude of the temperature inversion-caused disturbance under conditions of ground level γ spectral survey. The commercial three-channel car-carried γ spectrometer AGS-3 was used for the study. It was established that during ground γ spectrometric measurements of the concentration of uranium in the rocks the level of the disturbances associated with the temperature inversion reaches 15 to 20% of the measured magnitude with Clark concentrations of uranium in loose deposits. The assumption was made that for central and southern zones of the Soviet Union the level of these disturbances is from 50 to 100%. It was noted that disturbances of an inversion character must be particularly substantial in the scan of aerogram spectral measurement since these measurements are usually carried out in the early morning hours and moreover effective use of compensating or screening devices is excluded if the zone of increased RaC is below the airplane. (tr-auth)

29829 ENHANCING BACTERIAL ACTIVITY IN A URANIUM MINE. Duncan, D. W.; Bruynesteyn, A. (British Columbia Research, Vancouver). Trans. Can. Inst. Mining Met.; 74: 116-120(1971).

Acidic mine waters containing solubilized uranium were observed in many uranium and some copper mines. In every case, the sulphide and iron oxidizing bacterium, Thiobacillus ferrooxidans, was also present. This bacterium provides the ferric iron required to oxidize U^{4+}, both by oxidizing available ferrous iron and by oxidizing pyrite or other available sulphide minerals. This latter oxidation also provides sulphuric acid and may increase extraction by exposing more uranium. The enhancement of bacterial activity and the results of some field tests are discussed. (auth)

29830 MODEL OF CONTINUAL MASS-TRANSFER IN THE URANIUM-LEAD SYSTEM. Brandt, S. B.; Plyusnin, G. S. (Inst. of Geochemistry, Irkutsk, USSR). Geokhimiya; No. 7, 1067-1078 (Jul 1973). (In Russian).

A model of a uranium–lead system was developed in which the daughter product is lost due to diffusion or a first order reaction mechanism. Time scales for dissipated leads in alkaline feldspars were established and correlated with lead losses by uranium minerals. For a series of feldspars from the North American continent, as well as from the Ukrainian and Aldan shields, fair correlation of measured samples with the model and with Rb–Sr ages was obtained. The Pb/U isotopic ratios for radioactive accessory minerals of the corresponding regions fall on diffusion trajectories, which characterize the time of consolidation of these minerals. (auth)

Radioactive Effluents

Refer also to abstracts 29752 and 32011.

29831 (CONF-710501-P2, pp 857-865) RESPONSE OF BLUE GREEN ALGAE TO TECHNETIUM. Gearing, P. J.; Van Baalen, C.; Parker, P. L. (Univ. of Texas, Austin). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Technetium, a missing element on the earth, has chemical properties similar to the biologically important elements manganese and molybdenum. Technetium-99 as pertechnetate has a specific chemical effect on the blue-green algae Agmenellum quadruplicatum, Coccochloris elabens, and Anacystis nidulans. All three species behave similarly toward the ion, the only difference being in their relative sensitivities. A fraction of the algal cell population is killed upon initial exposure to pertechnetate, in the light. While the lethal concentration (about that of bromide in the ocean) may never be reached in an actual ecosystem, this completely artificial element which appears to be biologically active provides a unique tool for the study of the impact of a unique pollutant on ecosystems. (auth)

29832 SOME HEALTH PHYSICS ASPECTS OF RADIOLOGICAL SAFETY OF NUCLEAR POWER STATIONS FOR THE GENERAL PUBLIC. Konstantinov, Y. O. (Inst. of Radiation Hygiene, Leningrad). pp 373-377 of Health Physics Problems of Internal Contamination. Bujdoso, E. (Ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Various approaches for the calculation of radiological risk in siting of nuclear power stations are summarized. Some relationships are given that may be helpful for the interpretation of radiometric data and decision making in emergency. (auth)

29833 METHOD FOR THE EVALUATION OF RADIOACTIVE RELEASES AND ENVIRONMENTAL CONTAMINATION AROUND NUCLEAR POWER PLANTS IN NORMAL AND EMERGENCY OPERATION. Chorvat, D. (Research Inst. of Industrial Hygiene and Occupational Disease, Bratislava); Mizov, J.; Trnovec, T.; Hladky, E.; Skulec, S. pp 379-381 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A brief review of the principles of formation of a mathematical program for evaluation of radiological hazards in connection with releases of radioactivity from a nuclear power station is presented. (auth)

29834 GENERAL METHOD FOR ESTIMATING THE POPULATION EXPOSURE FROM THE PLANNED OR ACCIDENTAL RELEASE OF RADIOACTIVITY TO THE ENVIRONMENT. Frittelli, L. (CNEN, Rome). pp 383-386 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A general method is proposed for estimating the contribution from each radionuclide and each exposure pathway to the dose received from the members of the public owing to an accidental or planned release of radioactivity to the environment. The suggested method is based on a simple mathematical model that can be easily reduced to a system of first order, ordinary differential equations with constant coefficients. With this model the time-integral of the organ or tissue burdens and the resulting doses can be easily obtained without actually solving the differential equations. (auth)

29835 UTILIZATION OF ACTUAL AND MODEL ACCIDENTS FOR EMERGENCY SITUATIONS AT A NUCLEAR RESEARCH CENTRE. Chysky, J.; Sevc, J. (Inst. of Hygiene and Epidemiology, Prague). pp 387-390 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Results of the analysis of 42 small accidents are reported in which 117 persons were irradiated and contaminated at an experimental nuclear establishment, and of the analysis of five model accidents at two experimental nuclear reactors. Personnel failure participated in the causes of actual accidents and in errors of remedial actions at the model accidents by 86% and 44%, respectively. Physicians and psychologists may contribute to the prevention of accidents and to the effective procedure in handling of accidents, with the selection and preparation of persons at critical posts. (auth)

29836 RELEASE OF TRITIUM TO THE ENVIRONMENT DUE TO THE OPERATION OF RESEARCH AND POWER REACTORS. Dierkes, L.; Fendler, H. G. (Technishe Ueberwachungs-Verein, Mannheim, Ger.). pp 391-394 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The sources of tritium in nuclear reactors are discussed. The amounts of tritium produced are calculated and compared with that of operating reactors. It is shown, that the tritium production due to the rapid growth of nuclear power production does not lead to hazardous dose rates compared with the natural background radiation. (auth)

29837 DUST PROBLEM IN URANIUM MINING OPERATIONS AT JADUGUDA. Saha, S. C. (Bhabha Atomic Research Centre, Bombay). Indian J. Occup. Health; 15: No. 11, 1-7(Nov 1972).

Radiological health hazards other than the common health hazards due to dust encountered at the Jaduguda uranium mines in Bihar are evaluated. Threshold Limit Value (TLV) for dust and assessment of dust concentration during different operations are discussed. (INIS)

29838 USE OF VERMICULITE TO CONTROL DUST AND RADON DAUGHTERS IN UNDERGROUND URANIUM MINE AIR. Washington, R. A.; Chi, W.; Regan, R. (Dept. of Energy, Mines, and Resources, Elliot Lake, Ont.). Can. Mining Met. Bull.; 66: No. 731, 152-160(Mar 1973).

Full-scale statistically designed experiments with flow rates up to 10,000 cfm have been conducted on uranium mine air filtration with vermiculite as a filter material. Various filtration bed thicknesses were chosen, with different face velocities through each bed thickness. Results on total dust, respirable dust and radon daughter collection efficiencies were analysed statistically. It is shown that these collection efficiencies are directly related to the filter bed thickness. However, the different face velocities seem to affect only the collection of radon daughters. Optimum collection efficiencies for a clean bed of about 30% were found for respirable dust and radon daughters, and about 40% for total dust, using an 8-in.-thick bed and a face velocity of 500 fpm. Dust build-up on the filter bed during operation led to an increase in collection efficiency, reaching 40 to 60% after two weeks. (CA)

Radioactivity Monitoring and Transport

Refer also to abstracts 29616 and 30258.

29839 (CONF-710501-P2) RADIONUCLIDES IN ECOSYSTEMS. Proceedings of the Third National Symposium on Radioecology, Oak Ridge, Tennessee, May 10-12, 1971. Nelson, D. J. (ed.). (Oak Ridge National Lab., Tenn.). 1971. 602p. Dep. NTIS $16.60.

Seventy-one papers were presented at the conference. Separate abstracts were prepared for 47 of these and the remaining papers were abstracted previously and appeared in NSA as follows: Volume 25: 37218, 37748, 37753, 37756, 37757, 37795, 37868, 39807, 41690, 42717, 42718, 48373, 49117, 57,947; Volume 26: 2415, 4714, 4837, 6405, 15523, 20604, 41083, 45541; Volume 27: 12329, 15116. (HLW)

For abstracts of individual papers see: 29831, 29880, 29881, 29890-29897, 29913, 30043, 30072-30075, 30137-30145, 30234-30245, 30285, 30330-30333, 30376, and 32156-32158.

29840 (DPST-73-436) ENVIRONMENTAL ACTIVITIES AND PROGRAMS AT THE SAVANNAH RIVER PLANT. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Sep 1973. Contract AT(07-2)-1. 23p. Dep. NTIS $3.25.

Emission reduction activities in Savannah River Plant processes are summarized with regard to nuclear fuel fabrication facilities, nuclear reactors, chemical separations facilities, and supporting facilities. Environmental monitoring activities are summarized with regard to off-site monitoring and monitoring of streams, rivers, wells, and food chains. Emission monitoring of radioactive and nonradioactive wastes was also conducted. Administrative process controls are reviewed with regard to standards and operating guides, operating procedures, audit and review system, plant environmental committees, transport of radioactive materials, noise control procedures, and power conservation. The following environmental research activities are reviewed: environmental programs at Savannah River Ecology laboratory; forest management and research activities; Dose-to-Man program; National Environmental Research Park program; Par Pond limnology; thermal effects of heated streams; tritium migration in the environment; mercury in the environment; transport of pollutants in the Savannah River; and meteorological studies. (HLW)

29841 (HASL-276) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT. (Health and Safety Lab. (AEC), New York). 1 Oct 1973. 176p. Dep. NTIS $7.60.

Current data are presented from the HASL Fallout Program; The National Center for Atmospheric Research in Boulder, Colorado; The National Radiation Laboratory in New Zealand; and the EURATOM Joint Nuclear Research Centre at Ispra, Italy. The initial section consists of interpretive reports and notes on the global deposition of ^{90}Sr through 1972, sulfate concentrations in the lower stratosphere, global fallout in a forest compared with an open field, and detection of ^{192}Ir from recent nuclear tests in the southern hemisphere. Subsequent sections include tabulations of radionuclide levels in fallout, surface air, stratospheric air, milk, diet, and tap water. A bibliography of recent publications related to radionuclide studies is also presented. (auth)

29842 (HASL-276(App.)) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, JUNE 1, 1973-SEPTEMBER 1, 1973. (Health and Safety Lab. (AEC), New York). 1 Oct 1973. 459p. Dep. NTIS $10.60.

The following appendices to the quarterly summary are presented: ^{90}Sr and ^{89}Sr in monthly deposition at world land sites; radionuclides and lead in surface air; and radiostrontium in milk and tap water. Deposition of fallout ^{90}Sr and ^{89}Sr was monitored monthly at 35 sites in the United States and at 90 sites in other countries. Data from 1957 to 1973 are presented in tabular form. A study of the spatial and temporal distribution of nuclear weapons debris and lead in surface air was conducted. The study is described with regard to sampling sites and collection; gamma analysis; radiochemical analysis; stable lead analysis; analytical laboratories; and quality control. Results of monthly monitoring of surface air during 1963 to 1973 are tabulated for gross gamma concentration, ^{7}Be, ^{54}Mn, ^{55}Fe, ^{89}Sr, ^{90}Sr, ^{95}Zr, ^{109}Cd, ^{137}Cs, ^{141}Ce, ^{144}Ce, ^{238}Pu, ^{239}Pu, and stable lead. Tables are presented to show the ^{90}Sr to Ca ratio in milk of New York City; ^{90}Sr in New York City tap water; and the ^{137}Cs to ^{90}Sr ratio in New York City tap water. (HLW)

29843 (IAEA-R-421-F) RADIOACTIVE CONTAMINATION IN MARINE ENVIRONMENT AND BIOTA IN THE BASIN OF THE MEDITERRANEAN SEA. Part of a Coordinated Programme of Research in Marine Radioactivity Studies. Final Report, 1 December 1966-28 February 1971. Gilat, E.; Steiger-Shafrir, N. H. (International Atomic Energy Agency, Vienna (Austria)). Dec 1971. 1118p. INIS.

In order to evaluate the radioecological situation of the Eastern Mediterranean near the Israeli coast the conventional ecological studies on benthic fauna in this area were carried out. Based on these studies a sampling plan of seawater and marine biota for radiological measurements was established; these samples were analyzed for strontium-90 by using radiochemical separation procedures and low-level beta counting, and for cesium-137 by means of a low-level Ge(Li) gamma spectrometer. Laboratory

experiments with marine invertebrates were carried out to obtain some information on the uptake and loss of zinc-65 by these organisms under specific conditions encountered in the Eastern Mediterranean environment. The results of the radiological measurements showed that the levels of strontium-90 and cesium-137 in seawater and organisms in the area in question are more or less similar to those in other localities in the Northern Hemisphere. The uptake experiments of zinc-65 with a prawn Palaemon elegans demonstrated the rapid initial uptake, which can be interpreted as the accumulation of zinc-65 in the exoskeleton. (INIS)

29844 (NRL-F-50) ENVIRONMENTAL RADIOACTIVITY ANNUAL REPORT, 1972. (National Radiation Lab., Christchurch (New Zealand)). Apr 1973. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

Reference levels for radioactive fallout in milk, air, and rainwater were derived from ICRP dose limits. Comparisons of reference levels with natural radiation background are discussed and a summary of long-term monitoring results is presented. Tables and graphs are presented to show total beta activity in air and rainwater following nuclear weapons testing in the Pacific from 1962 to 1972. Tables are also presented to show specific data for ^{90}Sr, ^{89}Sr, and ^{210}Pb in rain; ^{90}Sr and ^{137}Cs in milk; ^{90}Sr cumulative deposition; and ^{90}Sr, ^{226}Ra, and ^{210}Pb in human bone. Measurement procedures and international comparisons of measurements are discussed. (HLW)

29845 BIOLOGICAL ASPECTS OF FALLOUT IN AUSTRALIA FROM FRENCH NUCLEAR WEAPONS EXPLOSIONS IN THE PACIFIC, MAY–AUGUST 1970. Canberra; Australian Government Publishing Service (1971). 6p.

The biological significance of fallout in Australia resulting from French nuclear explosions is described. In particular, the total β radioactivity in daily fallout deposition and the ^{131}I in daily milk samples were measured. Gamma radiation was also monitored. It was concluded that fallout involved was not a hazard to the Australian population. (AT)

29846 STUDY OF THE ABSORPTION OF NATURAL U AND ^{210}Pb BY POPULATION IN RELATION TO RADIOACTIVITY OF THE ENVIRONMENT IN AN AREA OF ROMANIA WITH INCREASED NATURAL BACKGROUND. Margocsy, N. (Medical Research Centre, Timisoara, Romania); Feraru, H.; Pomoje, R.; Plavosin, P.; Gavrila, F.; Racoveanu, N.; Furnica, G. pp 401-406 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

In an area of Romania with increased radioactive background, natural uranium and radiolead levels were estimated in urine samples from a local population group parallel with analyses of surface water, soil, and fodder vegetation samples (area "A"). A control group of an area with natural background was studied comparatively. The data obtained revealed the existence of radionuclide accumulations in area "A" both in environmental factors and in urine. In area "A" the local population is exposed to increased irradiation levels. (auth)

29847 NEED FOR ENVIRONMENTAL MONITORING FOR NUCLEAR INSTALLATIONS. Bhat, I. S. (Tarapur Atomic Power Station, India). Indian J. Occup. Health; 15: No. 11, 8-14(Nov 1972).

Increased use of radioisotopes for medicine, agriculture, and industry, fast growth of nuclear power industries and associated nuclear fuel production and reprocessing, produce large amounts of radioactive wastes. The radioactive gaseous and liquid wastes have to be dispersed safely in the environment. Environmental monitoring in general and India's approach to environmental monitoring in particular are discussed. Environmental survey work done at Tarapur by the Environmental Survey Laboratory (ESL), set up by the Health Physics Division of Bhabha Atomic Research Center during the preoperational and operational periods is reported. (INIS)

29848 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 8, 511-516(Aug 1973).

Data are presented on the environmental levels of radioactivity at Atomics International–Canoga Park, California during January to December 1971. Seismic signals, presumably from two Soviet underground nuclear explosions were recorded on July 9 and 22, 1973. (ERB)

29849 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 7, 457-462(Jul 1973).

Data are presented on the environmental levels of radioactivity at the Paducah Plant of the Union Carbide Corporation during January to December 1971. The USAEC conducted three underground nuclear tests at the Nevada Test Site during June and monitored one Chinese atmospheric nuclear test on June 26, 1973. (ERB)

29850 BARIUM IN THE ANTARCTIC OCEAN AND IMPLICATIONS REGARDING THE MARINE GEOCHEMISTRY OF Ba AND ^{226}Ra. Li, Y. H. (Swiss Federal Inst. of Tech., Zurich); Ku, T. L.; Mathieu, G. G.; Wolgemuth, K. Earth Planet. Sci. Lett.; 19: No. 3, 352-358(Jul 1973).

Ba distribution in the ocean correlates linearly with that of ^{226}Ra, reflecting little fractionation of the two elements in their uptake by marine organisms. The weight ratio of $^{226}Ra/Ba$ is estimated to be $(0.714 \pm 0.08) \times 10^{-9}$. A wide range of Ba/Si and Ra/Si values is noted in siliceous plankton collected from different oceans. This corroborates with the observations that, although silica co-varies with Ba and ^{226}Ra, the Ba/Si and ^{226}Ra/Si ratios in seawater vary from one area to another. Sediment pore water contains higher Ba concentrations than the overlying seawater. The resulting diffusive flux of Ba through the sediment-sea interface is estimated to be no more than 20% of the river input. The apparent oversaturation of dissolved Ba in pore fluids with respect to barite supports the idea that complexing of Ba with organic ligands may be important. Box model calculations show that: on a per unit area basis, ^{226}Ra flux from the continental shelf sediments is higher than that from the deep sea floor; and in the deep ocean, the magnitude of diffusive input of ^{226}Ra from sediments is about equal to the loss due to radioactive decay. (auth)

29851 OBSERVATION OF RADIORUTHENIUM AND RADIOCERIUM ISOTOPIC ACTIVITY RATIOS IN RAIN WATER. Matsunami, T.; Mizohata, A.; Mamuro, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 30-34(1972).

Since the end of 1969 the variation with time of the isotopic activity ratios of ^{103}Ru to ^{106}Ru and ^{141}Ce in rain water has been observed. In the period from November 1971 to August 1972 three main peaks of the two isotopic activity ratios appeared resulting from the twelfth (November 18, 1971), the thirteenth (January 7, 1972) and the fourteenth (March 18, 1972) Chinese nuclear explosions. The method of calculation, which was given by Telegadas and Murayama for estimating the contribution of the ^{90}Sr produced in a new explosion to the total deposition of ^{90}Sr from the observed isotopic activity ratio of ^{89}Sr to ^{90}Sr, was applied to estimate the contributions of the ^{106}Ru and ^{144}Ce produced in a new explosion to the total depositions of these nuclides. (auth)

Atmosphere

Refer also to abstracts 29759, 30093, and 30324.

29852 (AD-751542) NEW FALLOUT TRANSPORT CODE FOR THE DELFIC SYSTEM: THE DIFFUSIVE TRANSPORT MODULE. Supplement. Final Report, 6 May 1971–6 May 1972. Norment, H. G. (Mount Auburn Research Associates Inc., Newton, Mass. (USA)). Oct 1972. Contract DASA01-71-C-0118. 43p. (DASA-2669(Suppl.)). NTIS.

The Diffusive Transport Module of the DELFIC (Defense Land Fallout Interpretative Code) fallout prediction system has undergone additional development since publication of its description in DASA 2669. This supplement to DASA 2669 describes these developments and presents amendments and corrections to the code and its documentation. Complete FORTRAN statement listings of subroutines that have been substantially changed are included. (auth)

29853 (AD-751543) REVISED OUTPUT PROCESSOR MODULE FOR THE DELFIC FALLOUT PREDICTION SYSTEM. Final Report. Norment, H. G. (Mount Auburn Research Associates Inc., Newton, Mass. (USA)). Oct 1972. Contract DASA01-71-C-0118. 83p. (DNA-2962-F). NTIS.

The revised Output Processor Module of the DELFIC (Defense Land Fallout Interpretative Code) fallout prediction system is described and instructions are given for its use. Working in close liaison with the Particle Activity Module (DASA-1800-V), the Output Processor converts the output of the Diffusive Transport Module into a variety of displays in a directly contourable printed numerical (map) form. (auth)

29854 (AD-753842) DEPARTMENT OF DEFENSE LAND FALLOUT PREDICTION SYSTEM. Volume II. Initial Conditions, Supplement. Final Report. Norment, H. G. (Mount Auburn Research Associates Inc., Newton, Mass. (USA)). Oct 1972. Contract DASA01-71-C-0118. 33p. (DNA-1800-2(Suppl.)). NTIS.

The DELFIC (Defense Land Fallout Interpretative Codes) Initial Conditions Module code was revised to meet the requirements of the new DELFIC fallout prediction system. This documentation supplement describes the revised code. Discussion of the revised

code emphasizes particle size distributions. The code can accept parameters that define lognormal or power-law distributions, or it can accept a distribution in tabular form. Details necessary for use of the code are presented. FORTRAN statement listings of revised subroutines are included. (auth)

29855 (AD-762192) OPTIMUM WIND SOUNDINGS AND ARMY FALLOUT PREDICTION ACCURACIES. Shinn, J. H. (Army Electronics Command, Fort Monmouth, N. J.). May 1973. 35p. (ECOM-5489). NTIS.

The optimum period and spacing between atmospheric soundings required for fallout prediction are estimated on a cost effective basis. The fallout prediction procedures of Army TM 3-210 are used in conjunction with a model of wind variability, and an expression is derived to find the optimum sounding period for maximum cost effectiveness. Consideration of accuracy versus cost tradeoffs is used to show that if 6-hour sounding periods are the policy, they are optimum for nuclear yields up to 100 Kilotons (KT), and the acceptable error in downwind range prediction is about 50%. However, decreasing the error to 20% by shortening sounding periods results in 5-fold cost increase. Further losses of prediction accuracy with small cost savings are the result of increasing the sampling period. To continue to practice 6-hour sounding periods or to reduce the density of soundings to less than one per Corps would imply accepting an error larger than 20% in fallout prediction for weapons greater than 4 KT. (auth)

29856 (CONF-720823-P1, pp 322-332) EVALUATION OF MATERIALS AND TECHNIQUES USED FOR MONITORING AIRBORNE RADIOIODINE SPECIES. Keller, J. H.; Thomas, T. R.; Pence, D. T.; Maeck, W. J. (Allied Chemical Corp., Idaho Falls, ID). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Recent sampling studies at operating boiling water reactors indicated the majority of the iodine being emitted from the stack is non-elemental iodine. A laboratory study was conducted to determine the methyl iodine adsorption efficiency of various types of charcoal cartridges frequently used in sampling devices. Comparison data for silver zeolite is given. Both commercially packaged sampling units and laboratory-prepared units were evaluated. Also measured was the elemental iodine adsorption efficiency for commercially packaged charcoal samplers. Because environmental sampling involves sampling of air having very low concentrations of airborne iodine species, the tendency is to sample at high flow rates. This practice can only lead to the reporting of abnormally low results, especially for methyl iodide. Based on our studies, recommended criteria for sampler design and operation are given. (auth)

29857 (CONF-720823-P1, pp 333-345) EVALUATION OF A STACK SAMPLING SYSTEM USING A HELIUM MASS SPECTROMETER LEAK DETECTOR. Kerr, W. B.; McAtee, R. E.; Lakey, L. T. (Allied Chemical Corp., Idaho Falls, ID). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The flow of gas in the 250-ft stack at the Idaho Chemical Processing Plant was measured, and the isokinetic stack sampler was shown to obtain a sample which is representative of the several streams entering the stack. This was accomplished without direct access to the stack by determining the helium concentration in a stack gas sample stream when helium was released into the separate waste gas streams. A helium leak-detector was modified to provide a continuous record of the helium concentration in the stack gas sample. The technique of releasing helium and determining the concentration with this type equipment has other applications — such as, calibrating flow instruments, determining air-exchange rates in laboratories or buildings, and checking for conformance to antipollution standards. (auth)

29858 (CONF-720823-P1, pp 348-354) CONTROL OF RADON DAUGHTERS IN U. S. UNDERGROUND URANIUM MINES. Rock, R. L. (Bureau of Mines, Denver). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Control of radon daughters in U. S. underground uranium mines is still primarily a problem of quickly affecting a thorough and efficient exchange of contaminated underground mine air with fresh surface air. As radiation standards have been made more stringent, and as mines have been developed deeper and their workings have become more extensive, radiation control by ventilation alone has become more difficult. As a consequence, both mechanical air filters and electrostatic precipitators are now being used on a moderate scale as a means of supplementing the radiation control effects achieved by conventional ventilation. (auth)

29859 (CONF-720823-P1, pp 355-377) USE OF VERMICULITE TO CONTROL DUST AND RADON DAUGHTERS IN UNDERGROUND URANIUM MINE AIR. Washington, R. A.; Chi, W.; Regan, R. (Dept. of Energy, Mines, and Resources, Elliot Lake, Ont.). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

In uranium mines, the purification of underground mine air can be accomplished by the removal of dust particles and radon daughters using filters. Full-scale statistically designed experiments with flow rates up to 10,000 cfm have been conducted at Denison Mines Ltd. on mine air filtration with Vermiculite as filter material. Various filtration bed thicknesses were chosen with different face velocities through each bed thickness. Results on total dust, respirable dust and radon daughters collection efficiencies were analyzed statistically. It is shown that these collection efficiencies are directly related to the filtration bed thickness. However, the different face velocities seem to affect only the collection of radon daughters. Optimum collection efficiencies for a clean bed of about 30% were found for respirable dust and radon daughters, and about 40% for total dust, using an 8-in. thick bed and a face velocity of 500 fpm. Dust build-up on the filter bed during operation led to an increase in collection efficiency, reaching 40% to 60% after two weeks. (auth)

29860 (CONF-720823-P1, pp 378-398) REVIEW OF PROBLEMS AND TECHNIQUES FOR REMOVAL OF RADON AND RADON DAUGHTER PRODUCTS FROM MINE ATMOSPHERES. Goodwin, A. (Bureau of Mines, Washington, DC). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Ventilation with fresh air has been, and will continue to be, the primary solution for controlling employee exposure to radon and radon daughters in mines. Procedures to make the ventilation process more effective and to reduce contamination have been proposed; such as mine pressurization, construction of effective stoppings to seal old workings, and coatings to reduce radon inflow. Cleaning of mine air has been successful in certain applications. Removal of radon daughters can be accomplished by mechanical filtering and by electrostatic collection. Both of these methods remove condensation nuclei to which radon daughters become attached. Radon gas which passes through continues to decay; however, in the absence of condensation nuclei, the daughters have large diffusion lengths and are trapped on the walls of air courses. Thus the growth of daughters after filtering may be less than previously calculated without accounting for diffusion losses. Radon gas, itself, has been successfully removed from air, although there are no known reports of this having been done in operating mines. Capture in activated charcoal and silica gel has been accomplished. Chemical removal by reacting with a halogen fluoride and a metal fluoride has been demonstrated. (auth)

29861 CONCENTRATION OF ^{222}Rn, ^{220}Rn AND THEIR DAUGHTERS IN THE AIR, THE DEPENDENCE ON METEOROLOGICAL VARIABLES AND CONTRIBUTION TO THE RADIATION DOSE FOR THE INHABITANTS OF A RADON SPA. Steinhaeusler, F.; Pohl, E. (Research Inst. Gastein., Badgastein, Austria). pp 397-400 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

More than 1100 room-air measurements of the natural radioactivity due to Rn, Tn(^{220}Rn), and their decay products were carried out at Badgastein, a radon spa in Austria, and for comparison, at Innsbruck. The data obtained, together with various meteorological variables, were used for comprehensive regression analyses, with stepwise elimination of variables by a computer program. It was possible to determine those variables that account for the time variation of radioactivity in the air of a given (nonventilated) room. Hence the radiation dose due to inhalation was calculated for various organs. Estimated annual doses are given for groups of inhabitants and for workers in treatment rooms. (auth)

29862 DETERMINATION OF RADON AND ITS DAUGHTER PRODUCTS IN AIR USING TRIACETATE–CELLULOSE (TAC) FOILS. Domanski, T.; Chruscielewski, W.; Liniecki, J. (Inst. of Occupational Medicine, Lodz, Poland). pp 521-527 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The possibility of using triacetylocellulose foils for the determination of radon and the potential alpha energy of its decay products in mine air is theoretically considered from the viewpoint of radioactive equilibrium. Theoretical predictions were checked experimentally and found in basic agreement. Effects of humidity, temperature, and dust coverage upon final track density were studied. Sensitivity and accuracy of the method appear satisfactory for purposes of practical monitoring in mines. (auth)

29863 CONTROL OF LOW LEVEL AIRBORNE CONTAMINATION IN WORKING AREAS. Goldfinch, E. P. (Central Electricity Generating Board, Dungeness, Eng.). pp 529-533 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Experiments are described using tacky cloth collectors quantitatively for the assessment of low level airborne radioactivity. The deposition velocity for the collectors is determined as 0.01 cm/sec. Routine results are quoted. (auth)

29864 MONITORING FOR AIR CONTAMINATION WITH PORTABLE AIR SAMPLERS. Ullmann, W. (National Centre for Radiation Protection, Berlin). pp 535-538 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A new portable air sampler is described that was developed in the National Centre for Radiation Protection of the GDR. It contains a diaphragm pump that is electrodynamically driven. The pump unit is applicable for many purposes and well adaptable to special problems of measurements. The essential characteristic data of the first prototype model as well as of several filter materials are reported and some important possibilities for the application of the new type of air sampler are discussed. (auth)

29865 METHODS FOR ESTIMATING AIR CONTAMINATION BY RADIOACTIVE GASES AND AEROSOL PARTICLES. Bulanova, I. D.; Badin, V. I.; Batova, Z. G.; Vorobeev, A. M. (Inst. of Biophysics, Moscow). pp 543-546 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

In order to assess the current radiological situation it is necessary to know the contribution of activity of the dispersive medium to the total activity of the aerosol because the maximum permissible concentrations of these components are usually different. In monitoring practice, this relationship should be determined most frequently for such isotopes or their combinations as tritium, iodine, polonium, uranium, carbon, nitrogen, oxygen, and noble gases. Several methods exist for separate estimations of the activities of gases or vapors and of aerosol particles. The most important of these methods are dealt with. (auth)

29866 STUDY OF THE BEHAVIOR AND PROPERTIES OF AERODISPERSIVE SYSTEMS IN MODEL AND PRODUCTION PREMISES. Zalmanson, Y. E.; Nikitin, V. I.; Chutkin, O. A. (Union Research Inst. of Instrumentation, Moscow). pp 587-592 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The results of the measurement of aerosol concentration distribution are discussed in model and production premises. The relationship between the data of personal and stationary air sampling (PAS/SAS) is obtained. Recommendations are given for the calculation of the internal irradiation. (auth)

29867 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 7, 448-456(Jul 1973).

Data are presented on the gross β radioactivity in surface air and precipitation in the United States, Canada, and Pan America during March 1973 and the gross β radioactivity in surface air of Arizona, California, Nevada, and Utah during March 1973. (ERB)

29868 BIOLOGICAL ASPECTS OF FALLOUT IN AUSTRALIA FROM FRENCH NUCLEAR WEAPONS EXPLOSIONS IN THE PACIFIC, JUNE–AUGUST, 1971. Canberra; Australian Government Publishing Service (1972). 20p.

Three separate abstracts were prepared to cover the material in this book. (MCG)

For abstracts of individual sections see: 29869, 29870, and 29899.

29869 RADIATION DOSES TO THE AUSTRALIAN POPULATION FROM FRESH FISSION PRODUCTS IN FALLOUT. Gibbs, W. J.; Moroney, J. R.; Stevens, D. J.; Titterton, E. W. pp 4-5; 10-20 of Biological Aspects of Fallout in Australia from French Nuclear Weapons Explosions in the Pacific, June–August, 1971. Canberra; Australian Government Publishing Service (1972).

External γ-radiation doses to whole body from fallout of fresh fission products in Australia from June to November, 1971, following nuclear weapons tests by France in Polynesia, ranged from 0.1 to 2.2 millirad for the 26 centers monitored; they correspond to 0.1 to 2.2% of the average annual background radiation from natural sources. These whole-body doses are upper limits as no account is taken of the effects of weathering and shielding that would reduce actual doses by a factor of three to five. Radiation doses to thyroids of young children consuming fresh cows' milk following fallout over Australia of fresh fission products from the 1971 series of weapons tests in Polynesia, ranged from 4 to 62 millirad for the nine major milk supplies monitored. They are 0.5 to 7.4% of the dose, over a year, equivalent to the NRAC guide level, continuous exposure to which would not endanger the health of the population. The second explosion in the 1971 test series, which occurred on June 13, 1971, was responsible for most of the fallout of fresh fission products over Australia from the entire series. It is likely that explosion 2 involved a high yield device with a substantial fission component. This information was not included in official French statements on the test. Radiation doses to whole body and to thyroid, of the magnitude of those reported here from the fallout of fresh fission products in Australia during 1971, are considered by the NRAC to be of no significance as a hazard to health. (auth)

29870 MEASUREMENTS OF TOTAL BETA ACTIVITY IN THE FALLOUT. Kotler, L. H.; Nunn, R. O.; Stewart, F. M.; Thompson, R. D.; Wise, K. N. pp 5-7; 10-20 of Biological Aspects of Fallout in Australia from French Nuclear Weapons Explosions in the Pacific, June–August, 1971. Canberra; Australian Government Publishing Service (1972).

Following the 1971 series of nuclear weapons tests by France in Polynesia, measurements for 26 centers throughout Australia and New Guinea showed that the deposition of fresh fission products in fallout, which extended from June to November, 1971, was mainly at latitudes south of about 20°S. Although the levels of radioactivity remained low, the fallout persisted throughout the period and was dominated by material from explosion 2 that occurred on June 13, 1971. The upper limits of the external γ-radiation doses to whole body from the fallout range from 0.1 to 2.2 millirad. These doses are small, not only by comparison with the average annual background radiation from natural sources, but even compared with the variations expected in it. (auth)

29871 METHOD FOR IMPROVING THE COLLECTION PERFORMANCE OF IODINE SAMPLERS UNDER HIGH RELATIVE HUMIDITY. Noritomi, M. (Japan Atomic Energy Research Inst., Tokai); Yoshida, Y.; Fukuda, S. J. Nucl. Sci. Technol. (Tokyo); 10: No. 5, 292-300(May 1973).

In airborne radioiodine monitoring, it is essential to establish an effective sampling technique that gives results independent of the form taken by the radioiodine and that works effectively under high humidity. Experiments were made to improve the performance of an iodine sampler embodying (a) cellulose asbestos filter paper (Toyo Roshi, Type HE-40) and activated charcoal filter paper (Toyo Roshi, Type CP-20) and (b) HE-40 filter paper and activated charcoal cartridge (Toyo Roshi, Type CHC-50). Based on the results, a new sampler was devised in which the air is heated to 70 to 90°C before reaching the filters. The dependence of the collecting efficiency on the chemical form taken by the airborne iodine and also on the duration of sampling period was studied. Severe conditions of environment, such as high humidity, were simulated in the experimental apparatus. The airborne radioiodine used was a mixture of inorganic and organic iodides, identified by radiogas chromatography. It was found that the collecting efficiency of the sampler with activated charcoal cartridge and the activated charcoal filter paper, respectively, exceeded 99.5% and 85%, regardless of the form of airborne iodine even at 100% relative humidity throughout the whole range of sampling duration up to 16 hr. Under conditions of high humidity, the collecting efficiencies were found superior to that of charcoal filter paper and charcoal cartridge impregnated with TEDA or SnI_2 used without air heating. (auth)

29872 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 8, 498-510(Aug 1973).

The following radiation monitoring data are presented by various surface air and deposition surveillance networks: gross β radioactivity in surface air and precipitation in the United States and Canada during April 1973; gross β radioactivity in surface

air of California and Pan America during April 1973; and ^{90}Sr fallout in the United States and North and South America during 1971 (monthly averages). (ERB)

29873 RELATIONSHIPS AMONG VARIOUS ELEMENTS IN THE ATMOSPHERE OVER OSAKA DISTRICT. Mamuro, T.; Matsuda, Y.; Mizohata, A.; Matsunami, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 1-15(1972).

In order to study in detail the area dependency of the concentrations of various elements Na, Al, K, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Br, Rb, Ag, Cd, Sb, Cs, Ba, La, Cl, Sm, Lu, Hf, Ta, W, Pb, and Th in the atmosphere over Osaka district, simultaneous measurements of them were made at thirty stations by the use of instrumental neutron activation analysis and energy dispersive x-ray fluorescence analysis. From the measured average concentrations in four weeks, the concentration variation over the area was studied by calculating the coefficients of variation for 31 elements. In order to study the relationships among concentrations of various elements linear correlation coefficients were computed between all possible pairs of elements including dust concentrations. (auth)

Soil

29874 BEHAVIOR OF SOME CRITICAL RADIONUCLIDES IN SOILS: ^{137}Cs, ^{131}I, ^{89}Sr, AND ^{90}Sr. Benes, J. (Lab. of Radiological Dosimetry, Prague); Dlouhy, Z. pp 431-433 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

In order to evaluate consequences of soil contamination with radioactive materials, the rapid and effective determination of these substances in a given medium and also the regularities of their behavior in soils should be known. Therefore, sorption and desorption properties of five most spread types of soils in Czechoslovakia were studied. The results show that direct contamination of the sources of drinking and supply waters may be caused by iodine radioisotopes. Their penetration velocity into the earth's layers is great compared with that of cesium and strontium isotopes. Strontium and cesium are well retained by a majority of farmlands and their penetration into water-bearing formations is not possible. (auth)

29875 SOURCES OF TERRESTRIAL RADIATION. Natural Radionuclides in the Soil. Schales, F. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main); Keil, R.; Franke, T. (1973). vp. (In German).

From symposium on natural radiation exposure of man: basis for judging the radiation risk; Frankfurt am Main, Germany (18 Jul 1973).

Reviewed are the discovery, the origin, and significance of the soil's natural radioactivity and radionuclides, respectively, followed by a table of the most important long-lived radionuclides of the soil along with their modes of decay, their half-life periods and average concentration in soil. Because of the short range of α and β radiation in soil, air, and tissue, only the gamma-emitting radionuclides are of biophysical relevance, particularly the most frequent nuclides of the $^{238}U/^{226}Ra$ and ^{232}Th radioactive decay series, along with ^{40}K. A table is presented of the soil's most important natural gamma-emitting nuclides, their main spectral lines, and decay coefficients. The biologically significant total gamma dose rates above various geological formations are compared to each other. The percentage of ^{226}Ra, ^{232}Th, and ^{40}K in several kinds of stone is compiled, along with the concentrations of ^{222}Rn, ^{220}Rn, and ^{219}Rn as a function of the depth in soil. The dependence of the isotope exhalation on porosity and humidity of the soil, on pressure and humidity of the air, on soil and air temperature, and on direction and velocity of the wind is reviewed. An extensive bibliography is given, dating up to 1965. (GE)

29876 CONTINUOUS RECORDING OF WATER VAPOUR IN SOIL WITH THE AID OF TRITIUM LABELLING. Dammann, W. (Technische Univ., Hanover); Elmdust, M.; Kuehn, W. Kerntechnik; 15: No. 7, 306-311(1973). (In English and German).

Temperature gradients are responsible for condensation processes in superficial soil layers. The quantitative aspects of these processes, and their importance for the water budget of the soil and of the vegetation, are not yet fully understood. In particular, the participation of atmospheric humidity in the water balance of the soil as a result of temperature inversions has not been satisfactorily studied so far. Therefore, water vapor movement in a column of soil was studied with the aid of labelling with tritium. The quantities of water vapor were measured by measuring tritium activity in a flow-through type proportional counter. This ensured a very high detection sensitivity with continuous recording. It is planned to extend this technique to measurements in the field. (GE)

29877 EFFECT OF SORPTION ON THE MIGRATION OF ^{7}Be FROM A HIGH ENERGY ACCELERATOR CONSTRUCTED ON A CHALK SITE. Stapleton, G. B.; Thomas, R. H. (Rutherford High Energy Lab., Chilton, Eng.). Water Res.; 7: No. 9, 1259-1268 (Sep 1973).

The radioactive nuclides produced in rock surrounding a high energy accelerator installation may migrate from the accelerator environs if subjected to the hydraulic gradients of ground water. Under such conditions it might be possible for neighbouring ground water systems to become contaminated by long-lived radionuclides. This study concerns itself with the influence of chemical sorption in rock surfaces and its influence in minimizing leach rates. A specific study of the migration of ^{7}Be, an important radionuclide produced in accelerator shields, through ground predominantly composed of chalk is reported. Sorption is shown to play a dominant role in minimizing leach rates. (auth)

29878 RADON AND THORON EXHALATION FROM THE GROUND. Megumi, K.; Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai, Osaka, Japan). J. Geophys. Res. 78: No. 11, 1804-1808 (10 Apr 1973).

The rate of radon (^{222}Rn) and thoron (^{220}Rn) exhalation from the ground was measured in the yard of our laboratory to investigate effects of soil conditions on the exhalation; radon and thoron gases released from the ground were directly adsorbed on granular-activated charcoal, and the charcoal was subjected to γ ray spectrometry to estimate the activity of adsorbed radon and thoron gases. Although the rate of radon exhalation was not appreciably changed by a light rainfall, it apparently decreased after a heavy rainfall and remained low for several days. No appreciable seasonal difference was found in the radon exhalation. On the other hand, the thoron exhalation decreased more or less after every rainfall and depended strongly on the moisture of a thin surface soil layer. The rate of thoron exhalation in summer was about twice its value in winter. (auth)

29879 EMANATION OF RADON AND THORON GASES FROM SOIL. Megumi, K.; Mamuro, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 35-37(1972).

A soil sample originating from weathering of granite was sieved into six kinds of particle size. The contents of natural radionuclides in each classified soil sample and the radon and thoron exhalation from it were measured. Both the contents of ^{226}Ra (parent nuclide of radon) and ^{224}Ra (parent nuclide of thoron) were found to consist of two components for the samples of more than 10 mesh; one is proportional to the total volume of soil particles and the other proportional to the total surface area of soil particles. On the other hand, the content of ^{40}K showed no remarkable variation with particle size. The thoron emanating power was found to be 30 to 40%. It was revealed that smaller soil particles have more contribution to the radon and thoron exhalation from the soil surface than larger soil particles. (auth)

Water

29880 (CONF-710501-P2, pp 694-702) ZINC-65 IN OREGON-WASHINGTON CONTINENTAL SHELF SEDIMENTS. Cutshall, N.; Renfro, W. C.; Evans, D. W.; Johnson, V. G. (Oregon State Univ., Corvallis). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Approximately 520 Ci of ^{65}Zn is estimated to be present in sediments off the Columbia River mouth according to river discharge and measurements of ^{65}Zn concentrations in river water. Analysis of topmost 1 cm of shelf sediments for ^{65}Zr reveals that 45 Ci is present in this layer within an area bounded by a constant activity/area contour of 0.5 nCi/m^2 ($\sim 10^{10}$ m^2). Mean regression coefficients for six vertical profiles yield a half-value depth of 4.5 cm in sediment. Another 270 Ci is therefore estimated to be buried below 1 cm within the same area. The remaining 205 Ci appears to have been transported beyond the 0.5-nCi/m^2 boundary. These observations are compatible with known bottom currents in the shelf. (auth)

29881 (CONF-710501-P2, pp 936-944) TRANSPORT OF RADIONUCLIDES IN SEDIMENTS. Lerman, A. (Canada Centre for Inland Waters, Burlington, Ont.). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Patterns of distinct peak events in input of radionuclides into sediment may be easily obliterated by diffusion taking place in the interstitial waters of sediments. Rates of sedimentation derived from the positions of diffusion-broadened peaks in sediment

may give values exaggerated by factors of 2 to 3. Diffusion-sedimentation scale distances (D/U) in lake and oceanic sediments are in general appreciably greater than diffusion-decay scale distances ($\sqrt{D\tau}$); consequently, on the time scale of man-produced radionuclides, the rates of sedimentation do not significantly control the amount of radionuclides accumulating in the sediments by diffusion and uptake from overlying water. In a stratified sediment the chemical and physical characteristics of the thin layer near the sediment-water interface strongly control the amount of radionuclide accumulating in the sediment. Exchange and/or adsorption on solid particles in the sediment greatly affect the amount of radionuclide stored in sediment at steady state: for tritium in the Great Lakes, the amount stored in interstitial water without uptake by solids would be only 1 to 6% of the amount in lake water. For metal radionuclides characterized by strong uptake by solids, the amount stored in sediment may be 10 to 100 times greater than the amount in lake water at steady state. (auth)

29882 BEHAVIOR OF ^{134}Cs, ^{85}Sr, AND ^{65}Zn RADIONUCLIDES RELEASED TO WATER BASINS. A Study of an Experimental Laboratory Model. Weissbuch, H.; Clain, L.; Botezatu, E.; Freund, S.; Avaravarei, I. (Public Health and Medical Research Inst., Iassy, Romania). pp 421-430 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A laboratory experiment in a non-flowing regime was carried out to investigate the accumulation of ^{134}Cs, ^{85}Sr, and ^{65}Zn radionuclides in Danube and Siret basin sediments, as well as in Bicaz accumulation lake sediment. The influence of specific activity, water pH, and contact time upon the accumulation process was studied. (auth)

29883 RADIOACTIVITY OF SOME HUNGARIAN SPRING-WATERS AND THE DOSE ORIGINATING FROM THEIR CONSUMPTION. Csiky, I. (National Inst. of Public Health, Budapest); Gaal, A.; Polgar, E.; Toperczer, J. pp 441-444 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Activities of Hungarian spring-waters were measured. The internal dose originating from their consumption was found lower than the limit suggested for the population at large. (auth)

29884 DECONTAMINATION PROCESSES IN SOLID SCAVENGER-WATER SYSTEMS. Despotovic, R.; Despotovic, L. A.; Matker, N.; Subotic, B.; Zakoucka, J. (Rudjer Boskovic Inst., Zagreb). pp 445-449 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Since radiodecontamination of waters is a very important process several solid scavenger-water systems were investigated. The results of contamination-decontamination equilibria show a high yield of decontaminations with a nonisotopic scavenger in the SiO_2–$^{152,154}Eu$ systems, and a high decontamination capacity of montmorillonite in the montmorillonite–^{59}Fe systems. The dependences of incorporation of the radiocontaminants (self-diffusion or Ostwald ripening) on the ageing of the solid scavenger are shown in the AgI–^{110}Ag and AgI–^{131}I systems. Exclusion as the process causing increase in radiocontamination of waters is shown in the kaolinite–^{131}I systems. The importance of the described investigations for economic approach to the decontamination of waters is pointed out. (auth)

29885 REMOVAL OF FALL-OUT ^{90}Sr FROM LAND TO RIVER. Kamada, H.; Hukawa, M.; Saiki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo); 22: No. 6, 279-285(Jun 1973). (In Japanese).

During 1962 to 1969, in the drainage area of River Edo, River Agano and River Yodo, annual variation of the removal of ^{90}Sr from fallout into the river was analyzed in various discharge processes from hydrometeorological and radioecological situation. The following equation was obtained from the annual amount of discharged ^{90}Sr into the river $Q_{(Sr)}$ (Ci), annual precipitated fallout ^{90}Sr R (Ci), annual rainfall r (m) and its run off coefficient C_r and deposited ^{90}Sr in surface soil (depth; 0 to 5 cm) at the end of the previous year d (Ci), total deposited ^{90}Sr in soil D (Ci) in the drainage area, and C_1, C_2 and C_3, which were coefficients related to discharge processes of ^{90}Sr. $Q_{(Sr)} = C_1 \cdot R \cdot C_r + C_2 \cdot (R + d) \cdot r \cdot C_r + C_3 \cdot [D-(R + d)] \cdot r \cdot C_r$. The C_1, coefficient related to "channel precipitation" of ^{90}Sr, was negligible in the Edo River basin, 0.00626 in the Agano River basin and 0.0748 in the Yodo River basin, the C_2, coefficient related to "surface run off + a part of interflow" of ^{90}Sr, was 0.0110, 0.0187 and 0.0171, and the C_3, coefficient related to "the other part of interflow + ground water flow" of ^{90}Sr, was 0.00552, 0.00585 and 0.0104 respectively. In order to observe the patterns of annual discharged amounts in various discharge processes, hydrographical analysis was carried out and the same tendency was observed in the three river basins. The peak year of "channel precipitation" indicated the same peak year of R, and the peak of "surface run off + a part of interflow" delayed 1 to 2 years and that of "the other part of interflow + ground water flow" delayed 5 to 6 years after the peak of R. The $Q_{(Sr)}$ was 0.7 to 2 Ci in River Edo, 5 to 14 Ci in River Agano and 3 to 10 Ci in River Yodo, and the discharge rate of ^{90}Sr from soil in each drainage area into the river ($[Q_{(Sr)} - C_1 \cdot R \cdot C_r]/D$) was 0.2 to 0.4%, 1 to 2% and 1 to 2% respectively. (auth)

29886 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 8, 481-497(Aug 1973).

The following radiation monitoring data are presented by various water surveillance networks in the United States: gross α and β radioactivity in drinking water and surface water samples from California, Nevada, and Utah during February 1973; ^{89}Sr, ^{90}Sr, ^{226}Ra, ^{238}Pu, ^{239}Pu, ^{234}U, ^{235}U, and ^{238}U content of drinking water and surface water samples from California, Nevada, and Utah during 1972; gross β radioactivity and tritium content in surface water samples from New York during July to December 1971; gross radioactivity and tritium content of Columbia River water during July 1970 to June 1971; gross β radioactivity in surface water samples from Washington (other than Columbia River) during July 1970 to June 1971; and ^{32}P, ^{46}Sc, ^{51}Cr, and ^{65}Zn content (monthly averages) of Columbia River waters during 1964 to 1971. (ERB)

29887 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 7, 420-447(Jul 1973).

The following radiation monitoring data are reported from various water surveillance networks in the United States: gross α and β radioactivity in surface waters of the US during January 1969 to December 1970; tritium concentrations in tap water, surface waters, and precipitation in the US during January to March 1973; and gross α and β radioactivity and tritium content of surface waters and drinking water in California, Nevada, and Utah during January 1973. (ERB)

29888 FORM OF OCCURRENCE OF LONG-LIVED RADIONUCLIDES IN THE WATER OF THE RIVER DON. Stradomskii, V. B. (Hydrochemical Inst., Novocherkassk, USSR). Gidrokhim. Mater.; 54: 91-94(1970). (In Russian).

The radioactive isotopes ^{90}Sr, ^{137}Cs, and ^{144}Ce are present in the river water in the cation, anion, and neutral form. The principal form of occurrence for all three isotopes is usually the cation. Tentatively ^{90}Sr forms principally the cation forms Sr^{2+}. ^{137}Cs along with Cs^+ to a significant measure is present in the form of anion and neutral forms. The same can be said about ^{144}Ce, but the neutral form of this isotope is 10 to 13%. (tr-auth)

29889 VARIATIONS OF ISOTOPIC COMPOSITION OF URANIUM (^{234}U,^{238}U) IN UNDERGROUND WATERS AFTER EARTHQUAKE. Chalov, P. I.; Baranov, V. E.; Merkulova, K. I.; Tuzova, T. V. (Inst. of Physics, Mathematics, and Mechanics, Frunze, USSR). Litol. Polez. Iskop.; No. 1, 21-27(Jan 1973). (In Russian).

A study of the radioactive parameters of the underground waters before and after the Tashkent earthquake of April 26, 1966, showed that the changes of these parameters revealed some connection with the seismic phenomena. One of these parameters seemed to be the ratio of the activity $^{234}U/^{238}U$ in the underground waters, which is constant under usual conditions. The isotopic ratio $^{234}U/^{238}U = \gamma$ in the water after the earthquake was studied for 10 holes (36 determinations of the size of γ). It was established that the ratio of the activity $^{234}U/^{238}U$ in underground water does not relate to the number of radiological parameters according to whose changes the earthquake can be predicted. The character of the change of the size of γ for the wells studied showed that the change was connected not with single influx of large surplus of ^{234}U as a result of its leaching out from rocks destroyed in the earthquake but was caused by other reasons. Specifically this can be caused by constant or periodic influx into the water-bearing strata after the earthquake of "young" water or mixtures of water having different size of γ. The data obtained indicates that the ratio of the activity of $^{234}U/^{238}U$ in the underground water can be one of the radioactive indicators of the condition of the wells and of processes occurring in the water-bearing strata. The knowledge of the regularity of the change of this parameter in the underground water under normal conditions makes possible its use for the determination of the direction and rate of motion of underground water, for indication of the processes occurring in water-bearing strata after an earthquake, and possibly for the solution of other problems. (tr-auth)

Ecosystems and Food Cycles

Refer also to abstracts 30330, 30332, 30376–30378, 32125, 32186, and 32204.

29890 (CONF-710501-P2, pp 703-708) SPECIFIC ACTIVITY OF IRON-55 IN PACIFIC SALMON. Jennings, C. D.; Osterberg, C. L. (Oregon State Univ., Corvallis). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Fallout ^{55}Fe from the nuclear tests of 1961–62 was measured in Pacific salmon during 1964 to 67, and from these measurements the half-time for the loss of ^{55}Fe from the mixed layer of the North Pacific Ocean was estimated to be 11.5 months. On the assumption that salmon accumulate ^{55}Fe and stable iron in a ratio corresponding to the specific activity of ^{55}Fe in the seawater in which they feed, estimates are made of total ^{55}Fe in the North Pacific Ocean. Circumstantial evidence suggests that ^{55}Fe from fallout is in a form that is more readily available to marine organisms than the stable particulate iron in the ocean; thus fallout ^{55}Fe may not be an adequate tracer for stable particulate iron in the ocean. (auth)

29891 (CONF-710501-P2, pp 731-737) RADIOECOLOGY OF THE PLAICE (PLEURONECTES PLATESSA L.) IN THE NORTH-EAST IRISH SEA. Penthreath, R. J.; Woodhead, D. S.; Jefferies, D. F. (Fisheries Radiobiological Lab., Lowestoft, Eng.). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Of the radionuclides discharged from the UKAEA fuel processing plant at Windscale only ^{134}Cs and ^{137}Cs are accumulated to any extent in the flesh of the plaice (Pleuronectes platessa L.). From a study of the roles of food and water uptake of ^{137}Cs by I-group fish, which remain inshore throughout the summer, it was shown that approximately 50% is derived from each. The relationship between dietary changes and the contribution of food to the ^{137}Cs body burden was examined by monthly sampling of the gut contents of the plaice and the benthic fauna of the Windscale area. The internal radiation dose rates to the gonads of I-group plaice from the ^{137}Cs body burden and often radionuclides present in the gut were calculated using a simple model. As a large proportion of the Windscale radioactive waste, particularly ^{106}Ru, ^{144}Ce, and ^{95}Zr/^{95}Nb, is reconcentrated on the seabed silt, demersal fish may receive an external radiation dose that is significantly greater than natural background. In situ measurements of such external dose rates received by larger plaice were made with lithium fluoride dosimeters, and the results largely substantiate calculations based on seabed radioactivity levels. (auth)

29892 (CONF-710501-P2, pp 738-746) SEASONAL RADIONUCLIDE INVENTORIES IN ALDER SLOUGH, AN ECOSYSTEM IN THE COLUMBIA RIVER ESTUARY. Renfro, W. C. (Oregon State Univ., Corvallis). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Neutron activation products from the Hanford plutonium production reactors are present in all components of the Columbia River Estuary. Total amounts of the most abundant gamma emitters (^{65}Zn, ^{51}Cr, and ^{46}Sc) in Alder Slough water, sediments, plants, and animals were periodically estimated during 1968 to 1970. Inventories were made during winter, spring, and summer. Total amounts of the radionuclides in the ecosystem declined as Hanford reactors were shut down. By far, the greatest amounts of radionuclides were associated with the sediments. The biota accounted for only a small fraction of the total radioactivity present. Large seasonal fluctuations were noted in the total levels of the radionuclides in plants, animals, and detritus. (auth)

29893 (CONF-710501-P2, pp 747-751) ZINC-65 SPECIFIC ACTIVITY IN MYTILUS CALIFORNIANUS TISSUES. Larsen, I. L.; Renfro, W. C.; Cutshall, N. H. (Oregon State Univ., Corvallis). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Zinc-65 specific activity (nCi ^{65}Zn/g Zn) in soft parts of mussels living along the Pacific Northwest coast varies with distance from the Columbia River mouth. At any given site the specific activity in different tissues (muscle, gills, mantle, gonads, foot, and viscera) is less variable than either a measure of radioactivity or stable zinc concentrations. No significant uniform relationship between specific activities in different tissues is evident. Mussels 174 km south of the river mouth have higher ^{65}Zn specific activity than would be predicted by linear mixing of river water with seawater. (auth)

29894 (CONF-710501-P2, pp 752-768) STABLE MANGANESE AND MANGANESE-54 DISTRIBUTIONS IN THE PHYSICAL AND BIOLOGICAL COMPONENTS OF THE HUDSON RIVER ESTUARY. Lentsch, J. W.; Kneip, T. J.; Wrenn, M. E.; Howells, G. P.; Eisenbud, M. (New York Univ., NY). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The concentrations of stable manganese and ^{54}Mn in water, suspended sediments, bottom sediments, plankton, rooted aquatic plants, and fish were measured in samples from a 30-mile sector of the lower Hudson River Estuary during 1969 and 1970. Manganese-54 was introduced into this section of the Hudson primarily in operational waste from the Indian Point unit 1 reactor. Manganese-54 data are presented both in terms of activity per unit sample mass and as specific activity. The manganese content of several species of rooted aquatic plants was found to be proportional to the dissolved manganese concentration in water. However, several species of fish were shown to regulate manganese uptake or loss and maintain relatively constant manganese levels, regardless of variable concentrations of manganese in water. Manganese dissolved in water appears to be more biologically available than sedimentary deposits of manganese, as indicated by the specific activities of ^{54}Mn in water, bottom sediment, and biota. Manganese was found to leach from bottom sediments when seawater periodically intrudes into freshwater regions of the estuary, thereby increasing the concentrations of manganese in water. The use of concentration factors and specific activities in assessing the dosimetric consequences of ^{54}Mn releases into estuaries is discussed, and the limitations of these methods are pointed out. Supplementary data on salinity, freshwater discharge, suspended sediment load, water temperature, pH, and dissolved oxygen are included to allow generalization of observed phenomena to other similar estuaries. (auth)

29895 (CONF-710501-P2, pp 776-782) ACCUMULATION OF SOLUBLE AND PARTICULATE RADIONUCLIDES BY ESTUARINE FISH. Hoss, D. E.; Baptist, J. P. (National Marine Fisheries Service, Beaufort, NC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

A series of experiments was conducted to measure the accumulation of ^{65}Zn (soluble in seawater) and ^{144}Ce and ^{51}Cr (particulate in seawater) by estuarine fish, mummichog (Fundulus heteroclitus), flounder (Paralichthys sp.), Atlantic croaker (Micropogon undulatus), and menhaden (Brevoortia tyrannus). Comparisons were made between (1) accumulation of ^{65}Zn and ^{144}Ce from food and from water, and (2) accumulation of ^{65}Zn and ^{51}Cr in the presence and absence of a sediment substrate. Under experimental conditions the presence of a sediment substrate reduced the accumulation of both ^{65}Zn and ^{51}Cr by Atlantic croaker. Of the tissues analyzed, croaker muscle accumulated the least amount of both isotopes. Higher levels of ^{65}Zn were accumulated by mummichog from food than from water. In contrast neither mummichog nor flounder accumulated appreciable amounts of ^{144}Ce from food. Accumulation of ^{144}Ce in the gastrointestinal tract of menhaden was attributed mainly to swallowed seawater. (auth)

29896 (CONF-710501-P2, pp 783-790) IRON-55 AND RUTHENIUM-103 AND -106 IN THE BRACKISH-WATER CLAM RANGIA CUNEATA. Wolfe, D. A.; Jennings, C. D. (National Marine Fisheries Service, Beaufort, NC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Rangia cuneata, an estuarine clam, was collected at 4- to 6-week intervals during 1965 to 1967 from several stations over a 40-mile length of the Trent and Neuse Rivers in eastern North Carolina. The soft tissues were dried, ashed, and analyzed for gamma-emitting radioisotopes, ^{55}Fe, stable Fe, and other elements. Both ^{103}Ru and ^{106}Ru were more concentrated in clams collected from downstream stations at higher salinities than in clams from low-salinity water. A similar distribution was observed for ^{55}Fe. Ruthenium-103 appeared in Rangia within two weeks after the third and fifth Chinese nuclear tests, and its retention was resolved into two rate functions, with apparent effective half-lives of 40 days and 7 days. (auth)

29897 (CONF-710501-P2, pp 829-835) EXPERIMENTAL UPTAKE AND CHEMICAL FRACTIONATION OF IODINE-131 AND IRON-59 IN A TURTLE GRASS (THALASSIA TESTUDINUM) BED. Kolehmainen, S. E. (Puerto Rico Nuclear Center, Mayaguez). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Carrier-free $K^{131}I$ and $^{59}FeCl_3$ were added to a polyethylene container that had 0.12 m^2 of a turtle grass bed and 50 liters of seawater. At the sixty-second day the chemical fractionation of soluble ^{131}I in water was: 84% as $^{131}I^-$, 6% as $^{131}IO_3^-$, and 10% as organic ^{131}I. No Fe^{2+} or $^{59}Fe^{2+}$ was found during the experiment, but 51% of the total soluble ^{59}Fe was associated with soluble organic compounds and 49% was as $^{59}Fe^{3+}$ when the experiment was terminated. Suspended sediments contained 0.02 times as much ^{131}I and 0.25 times as much ^{59}Fe on the average as was in soluble form in the same water sample. Green leaves of turtle grass had the highest concentration factor for ^{59}Fe, and dead turtle grass leaves had the highest concentration factor for ^{131}I. Dead turtle grass and periphyton had taken most of the ^{131}I tracer, and sediments had accumulated most of the ^{59}Fe by the end of the experiment. The specific activities of ^{131}I and ^{59}Fe in the compartments of the turtle grass ecosystem that were in a steady state with the radioisotopes were the same as in water. However, the experiment showed that in order to apply the specific activity approach or steady-state concentration factors meaningfully, one has to know in which chemical form the elements and their radioisotopes occur in seawater. (auth)

29898 ^{137}Cs, ^{90}Sr, ^{210}Pb, AND ^{210}Po IN THE FOOD CHAIN OF LICHEN-REINDEER-MAN. Ramzaev, P. V.; Troiskaya, M. N.; Itabullin, M. S.; Litver, B. Y.; Nishnikov, A. I.; Teplykh, L. A. (Inst. of Radiation Hygiene, Leningrad). pp 417-420 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The new information is reported on ^{137}Cs, ^{90}Sr, ^{210}Pb, and ^{210}Po concentrations in the food chain lichen–reindeer–man in the Far North of the USSR during 1969 to 71. It is the first time that ^{90}Sr concentration has been measured in bone of reindeer-breeders (24 to 26 pCi/g Ca). The ^{210}Po content in the samples was 400 to 700 pCi/kg raw wt. (auth)

29899 MEASUREMENTS OF IODINE-131 IN MILK SUPPLIES. Bonnyman, J.; Duggleby, J. C. pp 7-20 of Biological Aspects of Fallout in Australia from French Nuclear Weapons Explosions in the Pacific, June–August, 1971. Canberra; Australian Government Publishing Service (1972).

Measurements of iodine-131 in milk consumed by 75% of the Australian population following the 1971 series of nuclear weapons tests by France in Polynesia, indicated that radiation doses to thyroids of young children ranged from 4 to 35 millirad for the major centers of population and up to 62 millirad for milk supplied from the dairying area around Malanda in North Queensland. These doses are small by comparison with 840 millirad in a year, the dose to thyroid equivalent to the NRAC protection guide, continuous exposure to which would not endanger the health of the population. (auth)

29900 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 8, 467-480(Aug 1973).

The following radiation monitoring data are presented from various milk and food surveillance networks: ^{90}Sr and ^{137}Cs content of milk samples from the US, Canada, and Central and South America during April 1973 and for the previous 12-month period; ^{89}Sr, ^{90}Sr, ^{137}Cs, and tritium content of milk samples from California, Nevada, and Utah during February 1973; and Ca, K, ^{90}Sr, and ^{137}Cs content of institutional diets of children in the US during July to September 1972. (ERB)

29901 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 7, 401-409(Jul 1973).

The following radiation monitoring data are reported by various milk and diet surveillance networks: ^{90}Sr and ^{137}Cs concentrations in milk in US, Canada, and Central and South America during March 1973 and for the 12-month period between April 1972 and March 1973; ^{89}Sr, ^{90}Sr, and ^{137}Cs in raw milk in South Carolina during October 1971 through December 1972, January and February 1972, and the previous 12-month period; ^{89}Sr, ^{90}Sr, ^{137}Cs, and tritium content of milk in California, Nevada, and Utah during January 1973; and Ca, K, ^{90}Sr, and ^{137}Cs content of institutional diets of children in the US during April to June 1972. (ERB)

29902 KONTAMINATION UND DEKONTAMINATION VON LEBENSMITTELN. Nr. 11. (Contamination and Decontamination of Food. No. 11). Fischer, E.; Strahlmann, B. (comps.). Bibliographien zur Kernforschung und Kerntechnik, Sektion 02, No. 11. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 51p. (In German).

The present bibliography covers 325 publications on the contamination of foods—with special reference to milk, meat, fish, cereals, and drinking water—with various radionuclides, either natural or artificial (mainly calcium, cesium, iodide, or strontium isotopes). Another eleven publications deal with the possibilities of decontaminating foods. Most of the literature has been issued in 1970 to 1972. The material has been grouped into several sections entitled General aspects, Radioecology, Contamination, and Decontamination. The bibliographic part is supplemented by author, subject, conference and report number indexes. (GE)

Radiometric Techniques

29903 APPLICATION OF ISOTOPE METHODS FOR THE INVESTIGATION OF GROUND WATER POLLUTION. Moser, H.; Neumaier, F.; Rauert, W. (Gesellschaft fuer Strahlen und Umweltforschung mbH, Nuemberg). (1973). vp. (In German).

From symposium on groundwater and environment; Essen, Germany (2 May 1973).

A review is given of the application of hydrogeological investigations in combination with radioactive tracer techniques for the indirect detection of pollutants. The method permits to predict the possible propagation of pollutants which are discharged into surface and ground water. Some practical examples with special regard to environmental protection are given. (GE)

29904 EXISTENCE OF A STRONG DISEQUILIBRIUM BETWEEN URANIUM ISOTOPES. Effect on Dating Bamian Travertins (Central Afghanistan) Using the $^{230}Th/^{234}U$ Method. Nguyen Huu Van (CNRS, Gif-sur-Yvette, France); Elbez, G.; Lalou, C.; Lang, J.; Lucas, G. Compt. Rend., Ser. D; 276: No. 15, 2233-2236(9 Apr 1973). (In French).

An interpretation of the disequilibrium mechanism between the activities of ^{234}U and ^{238}U is presented. The use of $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ ratios to date a series of Afghanistan travertins is then discussed. (FR)

29905 NUCLEAR GEOPHYSICAL EXPLORATION. Artsybashev, V. A. Moscow; Atomizdat (1972). 400p. (In Russian).

The nuclear geophysical methods of the exploration of deposits of useful minerals are discussed systematically. Besides the prerequisites for the use of γ and neutron methods according to each of the basic methods a description is given of the theory, operating method, interpretation of the results, present-day apparatus, possibilities of the search and prospecting of different useful minerals. The characteristics of the use of nuclear geophysical methods for well logging, mapping, and sampling of useful minerals in mines are examined. The role and position of nuclear geophysical studies in complex geophysical work during the exploration of useful minerals are examined specially. (tr-auth)

29906 YADERNO-GEOFIZICHESKIE METODY. (Nuclear Geophysical Methods). Filippov, E. M. (ed.). Novosibirsk, USSR; Izdatel'stvo Nauka Sibskoe Otdelenie (1972). 384p.

New modifications of nuclear geophysical methods of study are examined. A method for the three-dimensional location of scattered γ radiation is reported. This method makes it possible to eliminate the effects of neighboring zones on the results of the measurement of the density of mountainous rocks and ores. Neutron activation and neutron resonance methods of rapid analysis of samples of mountainous rocks and ores are reported. The use of isotopic neutron sources for the study of bore holes by the method of neutron-neutron logging by measurement of the lifetime of thermal neutrons is reported. With respect to questions of coal prospecting and industrial geophysics, information on new methodic developments connected with pulsed neutron-neutron logging during the appearance of oil-bearing and water-bearing strata are discussed. Methods for the determination of fluorine and other ores and also for the determination of rock-forming elements (oxygen, silicon, aluminum, sulfur, etc.) are examined. A description is given of the development of a twin-wave bore γ-γ densimeter, operating on the principle of the sonar. A portable γ spectrometer, a neutron coring radiometer, and a core neutron generator are also described. (tr-auth)

29907 ION MICROPROBE CONFIRMATION OF Pb ISOTOPE RATIOS AND SEARCH FOR ISOMER PRECURSORS IN POLONIUM RADIOHALOES. Gentry, R. V.; Cristy, S. S.; McLaughlin, J. F.; McHugh, J. A. (Oak Ridge National Lab., TN). Nature (London); 244: No. 5414, 282-283(3 Aug 1973).

It is stated that radiohaloes associated with the decay of several Po α-emitters have been studied recently by mass spectrometric examination of the halo inclusions using ion microprobe techniques. The finding of a large excess of ^{206}Pb compared with ^{207}Pb was incompatible with the radiogenic decay of ^{238}U and ^{235}U, but was explainable on the basis of Po decay independent of U. Attempts to account for the origin of these Po haloes by assuming that Po was incorporated into the halo inclusion at the time of host mineral crystallisation meet with severe geological problems; the half-

lives of the Po isotopes are too short to fit anything but a rapid mineral crystallisation, contrary to accepted theories of magmatic cooling rates. This problem might be resolved if several long half-life high-spin isomers of Po, or β-decaying precursors, were formed at nucleosynthesis. This hypothesis is open to experimental verification, using several techniques such as charged particle reactions, although the long half-lives may present an obstacle; but long half-lives imply that some of the isomers may still exist, in which case a mass analysis of the Po halo inclusions should reveal whether significant quantities are still present. Additional ion microprobe analyses of Po inclusions, as well as U inclusions, are described, in search of the isomers and for additional information on the Pb isotope ratios. (UK)

29908 ANALYSIS OF THE POSSIBILITY OF EMPLOYING THE BLOCK DIAGRAM RECORDING OF URANIUM AND THORIUM CONTENTS IN THE SPECTROMETRIC GAMMA WELL LOGGING. Novikov, G. F.; Sinitsyn, A. Ya.; Koznyda, Yu. O. Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 3, 111-115(Mar 1972). (In Russian).

The effect of intermediary zones on the precision of determining the concentration of uranium and thorium in wells by the use of a two-channel block recording of the concentration and a two-channel γ spectrometer was investigated. The relative error in the determination of uranium and thorium in the range of Th/U ratios of from 0.1 to 10 without supplementary fine adjustment of the block recording does not exceed $\pm$ 10% at thickness of the intermediary zone of 1 cm of iron or 6 cm of water. (tr-auth)

29909 DISTRIBUTION OF NEUTRONS FROM URANIUM SPONTANEOUS FISSION IN HETEROGENEOUS MEDIA WITH CYLINDRICAL INTERFACES. Davydov, Yu. B. (Sverdlovsk Mining Inst., USSR). Izv. Akad. Nauk SSSR, Fiz. Zemli; No. 10, 106-111(Oct 1972). (In Russian).

The determination of the concentration of uranium through the γ emission of radium decay products requires the prior knowledge of the coefficient of radioactive equilibrium which can cause considerable fluctuation even at the boundary of one ore body. Considerable errors can appear also in connection with the influence of factors distorting the results of γ coring (influx of radium and radon-containing water, emanation, the presence of thorium, etc.). Therefore there is great interest in the development of methods of direct determination of uranium in bores which involves the registration of neutrons of spontaneous fission of uranium nuclei. A solution was carried out on the problem of the distribution of neutrons in the presence of some coaxial cylindrical interfaces, analogous to real conditions, existing in the logging of cores, that is, the boundary problem of the theory of logging of neutrons of spontaneous fission of uranium with consideration of the effect of the neighboring zone. The formulas obtained, describing the distribution of subthermal and thermal neutrons of spontaneous fission in wells (j = 1) can be used for calculation of the effect of neighboring zones on the logging results. It was established that the presence of water in the core causes the absorption of fast and the storage of thermal neutrons in the core. (tr-auth)

Site Surveys

Refer also to abstracts 32068, 32102, and 32103.

29910 (NILU-TN-23/72) QUALITATIVE EVALUATION OF AFFECTED AREAS FOR VARIOUS POSSIBLE NUCLEAR POWER PLANT SITES. Affected Area/Population Distribution. Sivertsen, B. (Norsk Institutt for Luftforskning, Kjeller). Feb 1972. 51p. (In Norwegian). Dep. NTIS (U. S. Sales Only) $4.75.

A qualitative relative evaluation is made of a number of potential nuclear power plant sites in the Oslofjord district, based on previous reports in this series. The data is presented in tabular form and on maps which also indicate population distribution. Comments are given both in the tables and in accompanying text. (NO)

29911 (NILU-TN-23/72(Add.)) AREA EFFECTS ON POPULATION DISTRIBUTION FOR RELATIVE CONCENTRATIONS > 10^{-5} $s.m^{-3}$ WITH EXPECTATION 1, 5, AND 10. Sivertsen, B. (Norsk Institutt for Luftforskning, Kjeller). Feb 1972. 10p. (In Norwegian). Dep. NTIS (U. S. Sales Only) $3.00.

Supplementary data to that given in the main report on population density of potential nuclear power plant sites in Oslofjord District, Norway is presented. This consists mainly of maps showing areas affected by relative concentrations expected with a frequency of 1% in directions across the prevailing wind directions. (NO)

29912 (USGS-474-163) GEOLOGIC AND HYDROLOGIC EFFECTS PREDICTION AND EFFECTS PROGRAM, ALMENDRO (U19v) EVENT, PAHUTE MESA, NEVADA TEST SITE. Special Studies-92. (Geological Survey, Denver, Colo.). Oct 1973. Contract AT(29-2)-474. 38p. Dep. NTIS $4.00.

The Almendro event is scheduled for drill hole U19v on Pahute Mesa, Nevada Test Site. U19v was drilled into lavas and tuffs that filled the Silent Canyon volcanic caldera and bottomed in a rhyolitic lava flow of the lava and tuff of Dead Horse Flat. Good correlations from U19v to UE19i eliminated the necessity of drilling an exploratory hole at the U19v drill site. The hydraulic gradient in the U19v area is to the southwest. The static water level in U19v is estimated to be 2,285 feet in depth, and transmissivity is low. As much as 40 centimeters of displacement resulting from detonation of the Almendro event may be expected along faults within about a 3-kilometer radius of U19v. Also, parts of the Greeley fault zone may have minor fracturing at a distance of 5 kilometers from U19v. The hydrologic effects of Almendro event in U19v are expected to be similar to those produced by earlier explosions of intermediate and high yield at Pahute Mesa. Almendro's effects program consists of ground deformation measurements, fracture mapping to record surface rupture, and fault movement documentation. In addition, 6 to 10 drill holes and water wells will be monitored for hydrologic effects of Almendro. Surveying of strain nets and level lines, monitoring of seismic activity, and high-speed motion picture photography of U19v GZ area are recommended. (auth)

Thermal Effluents

Refer also to abstract 31818.

29913 (CONF-710501-P2, pp 1029-1033) THERMAL EFFECT ON FEEDING COMPETITION BETWEEN RAINBOW TROUT AND BLUEGILL. Bowen, S. H.; Coutant, C. C. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

29914 (COO-2158-9) INVESTIGATION OF THE INFLUENCE OF THERMAL DISCHARGE FROM A LARGE ELECTRIC POWER STATION ON THE TEMPERATURE AND NEAR-SHORE CIRCULATION OF LAKE MICHIGAN. Quarterly Progress Report, July 1, 1973-September 30, 1973. Mortimer, C. H.; Sato, G. K. (Wisconsin Univ., Milwaukee. Center for Great Lakes Studies). 1973. Contract AT(11-1)-2158. 4p. Dep. NTIS $4.00.

29915 THERMAL LOAD CAPACITY OF THE RHINE RIVER. Mueller, R. E. Z. Wasser-Abwasserforsch.; 5: No. 6, 180-187 (1972). (In German).

With a calculating program and considering the natural cooling, the thermal effects of existing and planned power stations, industrial enterprises, waste water drainage, etc. on the water temperature of the River Rhine were simulated. The actual geometry and the hydrological characteristics of the river system, the measured meteorological and environmental conditions, as well as the heat supply or heat removal by technical sources of heating or cooling serve as a basis for the calculation of a temporal process of the river water temperature. The results were compared with the measured temperatures. After this test simulations with several power stations, still under construction or planned, were carried out and are discussed. (auth)

Chemical Effluents

29916 ENERGY, MAN, AND ENVIRONMENT. Bailey, R.; Broadbent, D.; Esposito, J.; Gaskell, T. F.; Hunzinger, W.; Kade, G.; Knapp, S. R.; Lal, S.; Liebrucks, M.; Menke-Glueckert, P. (1973). vp. (In German).

From international symposium "energy-man environment"; Rueschlikon, Switzerland (3 Feb 1972).

Reports and discussions are given from the studies meeting of the Gottlieb-Duttweiler-Institute which took place from 3rd to 5th February, 1972. The subjects of the meeting are energy demand and production growth limits, and effect of the energy production on the environment. (GE)

INSTRUMENTATION

Radiation Detection Instruments

29917 RESPONSE FUNCTION OF THE CHARGE COLLECTION PROCESS (RIGOROUS PROOF). Lomashevich, S.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Semicond. 6: No. 10, 1711-1713 (Apr 1973).

A rigorous derivation is given of the fundamental response function of a nuclear-particle detector excited by monoenergetic particles. It is assumed that nuclear particles are scattered many times in matter. (auth)

General Detectors and Monitors

Refer also to abstracts 29695, 29801, 29864, 30304, 30305, 30309, 30312, 30380, 30385, 30394, 30672, and 31736.

29918 (AD-749099) DEVELOPMENT OF A HIGH-ENERGY NEUTRON DETECTOR. Final Report. Benton, E. V.; Frank, A. L. (San Francisco Univ., Calif. (USA). Dept. of Physics). 15 Jun 1972. Contract DASA01-71-C-0065. 47p. (DNA-2918-F). NTIS.

A detector is being developed for the measurement of high-energy neutron fluences. A series of neutron energy thresholds are employed to yield spectral information. The method employed is to measure the fluences of elastically scattered recoil nuclei from low Z ($4 < Z < 8$) materials. Nuclear track recorders are used for this purpose. A cellulose nitrate track recorder which selectively registers recoil nuclei in the presence of ^{4}He particle backgrounds has been developed. Neutron energy thresholds are due to selected thicknesses of gold degrader films which separate the recoil particle radiator and the track recorder. A computer code (FLUENZ) has been written to supplement detector response measurements and to determine response over the full useful neutron energy range. Another computer code (HENDU) is being adapted to the unfolding of neutron spectra from the detector measurements. (auth)

29919 (CERN-73-11) HIGH-ACCURACY MEASUREMENTS OF THE CENTRE OF GRAVITY OF AVALANCHES IN PROPORTIONAL CHAMBERS. Charpak, G.; Jeavons, A.; Sauli, F.; Stubbs, R. (European Organization for Nuclear Research, Geneva (Switzerland)). 24 Sep 1973. 12p. Dep. NTIS (U.S. Sales Only) $3.00.

By measuring the center of gravity of the pulses induced in the cathodes of a multiwire proportional chamber, the position of the avalanche can be determined with a high accuracy. The inherent accuracy of the method is at least of the order of 15 microns. The accuracy is determined only by the spatial extension of the avalanches. With x-rays of 6 kV, the accuracy is at least σ = 150 μm along the wire. The conditions for interpolation between the wires are discussed. (auth)

29920 (CONF-730301-P1, pp 213-226) SELF-POWERED BREMSSTRAHLUNG MONITORS. Hewitt, J. S. (Univ. of Toronto) 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Reviewed in this paper are the basic developments and the applications of self-powered detector systems for precisely monitoring bremsstrahlung beams used for radiation processing, therapy, or research. The brief history of self-powered detectors and reports on experimental and theoretical studies of detector response are discussed. Details of detector variations which permit continuous energy and positional information on the bremsstra lung beam to be obtained are presented. For example, one system is capable of monitoring the position of the centroid of individual beam pulses to within 0.1 mm. (auth)

29921 (CONF-730321-) SEMICONDUCTOR DETECTORS IN MEDICINE, SAN FRANCISCO, MARCH 8–9, 1973. (Division of Biomedical and Environmental Research, Washington, D. C.). 1973. 506p. Dep. NTIS $13.60.

Separate abstracts were prepared for 8 of the 18 papers presented. Seven of the remaining papers were not in scope for NSA and three papers were previously abstracted in NSA. (WHK)

For abstracts of individual papers see: 29922–29927, 30380, and 30381.

29922 (CONF-730321-, pp 22-52) DESIGN CONSIDERATIONS AND APPLICATIONS OF IN-VIVO SILICON DETECTORS AND IN-VIVO AMPLIFIERS. Friedland, S. S. (Tel Aviv Univ., Israel); Katzenstein, H. S. 1973.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

In semiconductor detectors in medicine.

The design and fabrication and the operating parameters of microminiature silicon semiconductor detectors and preamplifiers which are capable of operating in-vivo are described. Various biomedical applications are discussed including eye tumor detection, brain tumor removal, and localization of gastrointestinal tract bleeding centers. (WHK)

29923 (CONF-730321-, pp 53-86) RECENT DEVELOPMENTS IN SEMICONDUCTOR RADIATION DETECTORS. Martini, M. (Simtec Industries Ltd., Montreal). 1973.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

In semiconductor detectors in medicine.

In the last few years an intense effort has been made to develop highly gamma sensitive semiconductor radiation detectors stable or operable at room temperature. The results of this effort, especially from the standpoint of nuclear medicine, are reviewed. (auth)

29924 (CONF-730321-, pp 189-236) SILICON PROBES FOR PHYSIOLOGICAL STUDIES: EXPERIENCE, LIMITATIONS, AND PERSPECTIVES. Marcus, C. S. (Univ. of Southern California, Los Angeles). 1973.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

In semiconductor detectors in medicine.

The use of silicon avalanche and Si(Li) radiation detector probes for a variety of biomedical applications are discussed. Techniques for measuring x- and γ-rays, soft β^-, hard β^-, and positron particles (β^+) are evaluated. Methods which will hopefully lead to clinically useful procedures for the evaluation of periodontal lesion healing and the diagnosis of prostatic carcinoma are described. A variety of in vivo, in vitro, and analytical applications for biochemical and physiological research are introduced and discussed. Some considerations of radiopharmaceutical design with respect to semiconductor radiation detector probe procedures are presented. (auth)

29925 (CONF-730321-, pp 399-435) HUMAN LOCAL CEREBRAL BLOOD FLOW STUDIES USING ULTRAPURIFIED GERMANIUM MULTIDETECTOR ARRAYS. Barker, J. N.; Youdin, M.; Reich, T. (New York University School of Medicine, NY). 1973.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

In semiconductor detectors in medicine.

The need and a method for achieving three-dimensional resolution of brain blood flow distribution is described, with some comments upon applicability to problems of early cerebrovascular insufficiency and tumor diagnosis. After demonstrating feasibility of utilizing high-purity germanium detectors in modular arrays, a multidetector, multiplanar array has been designed to employ this method. Its characteristics and some uses of the prototype are discussed. (auth)

29926 (CONF-730321-, pp 436-467) OPERATIONAL CHARACTERISTICS OF A SMALL ULTRA-PURE GERMANIUM GAMMA CAMERA. Detko, J. F. (Memorial Sloan-Kettering Cancer Center, New York). 1973.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

In semiconductor detectors in medicine.

The fabrication of the matrix array of Ge semiconductor detectors is described, and preliminary test results are discussed. The test results indicate that it is capable of providing significant spatial resolution below 200 keV. (WHK)

29927 (CONF-730321-, pp 468-501) INITIAL PERFORMANCE OF POLAR COORDINATE Ge(Li) GAMMA CAMERA. Strauss, M. G.; Sherman, I. S.; Brenner, R.; Lenkszus, F. R. (Argonne National Lab., IL). 1973.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

In semiconductor detectors in medicine.

A γ-ray camera using a 50 mm diameter coaxial Ge(Li) detector is being developed. The location of a γ-ray interaction in the detector is recorded in polar coordinates. The signal from a broadband low-noise cryogenic preamplifier connected to the p-core is differentiated to recover the current pulse. The radial distance is determined from the difference between the rise and fall times of this pulse. The angle is determined from the pie-shaped detector sector in which the γ-ray interacted. To evaluate this camera concept the pie-shaped sectors were simulated by a lead mask with a

wedge-shaped opening that rotates in front of the detector. The angle is given by the position of the wedge-opening. Coordinate signals corresponding to one or more selected γ-ray energies are stored in a small computer which converts the polar coordinates to Cartesian coordinates and displays the image on a raster of 3000 uniformly distributed points. The radial position response of the detector was measured with a collimated 1 mm^2 γ-ray beam from a ^{57}Co source (122 keV). Peaks corresponding to positions 2.5 mm apart along the radius were clearly resolved. A FWHM of 1.3 mm was observed. The intrinsic spatial resolution of the camera was obtained from a shadowgraph produced by flooding a test pattern with γ rays from a ^{57}Co source. The pattern consisted of lead bars, dots and a rectangle with holes. Bars 1 mm wide spaced 1 mm apart were resolved. Dots, simulating "cold" lesions, and holes, simulating "hot" lesions, of 1 mm diameter could be seen. A period of 10 min was adequate to image the pattern, using a 10 mCi source at 70 cm from the detector. The insertion of 5 cm of tissue equivalent scattering material (plexiglass) between the detector and the test pattern had no perceptible effect on the image. Energy resolution (FWHM) of 1 keV permits full efficiency to be obtained when the pulse height selector window baseline was only 1 keV below the peak centroid. The dual isotope technique was simulated by imaging simultaneously ^{57}Co (136 keV, identical to ^{75}Se) and ^{99m}Tc (140 keV). Though the energies are only 4 keV apart, the two images were completely resolved without sacrificing efficiency. (auth)

29928 (COO-2009-49) INDIANA UNIVERSITY PROPORTIONAL CHAMBERS. Crittenden, R. R.; Krider, J. C. (Indiana Univ., Bloomington). 1973. Contract AT(11-1)-2009. 11p. Dep. NTIS $3.00.

The mechanical construction, basic electronic layout, and performance of multiwire proportional counters at the Indiana University are presented. (TFD)

29929 (FRNC-R-19, pp 104-106) CHARACTERISTICS OF A SIMPLIFIED WHOLE-BODY COUNTING SYSTEM. Comparison of Its Performance With That of a Classical System. Frossard, H.; Perles, R.; Poutrain, P. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The characteristics of stationary whole-body counting systems and portable systems differ. Heavy stationary installations enable all types of examination to be performed and are to be preferred whenever the cost problem and lack of mobility can be overcome. This type of instrument is very accurate. Light-weight portable installations are an alternative; nevertheless the suspect cases detected must be referred to a stationary installation. However, portable installations have great flexibility and are recommended in wartime or in the event of catastrophies. In addition, less expert knowledge is required of the operating personnel than with stationany installations. (FR)

29930 (INIS-mf-770) DESCRIPTION, CHARACTERISTICS, AND PERFORMANCE OF A PROTOTYPE WHOLE-BODY COUNTER FOR CLINICAL USES. Kieffer, J. (Sao Paulo Univ. (Brazil). Faculdade de Medicina). 1970. 119p. (In Portuguese). INIS.

Thesis.

A whole-body counter (IEA-II) with a moving detector (3'' × 3'' NaI) and a special colimator was developed for clinical uses. The counter permits measurements in the range 1.6×10^{-2} to 5.2×10^{-1} microcuries at energies of 0.12 to 1.86 MeV, at a distance of 65 cm., in an interval of 30 minutes, with 1.5% statistical deviation. The counter, weighing approximately 700kg (1500 lb), costs Cr$ 50,000,00 (US$ 8,500). (INIS)

29931 (LA-5394-MS) ARITHMETIC BOX FOR ENRICHMENT METER AND NEUTRON ASSAY INSTRUMENTS. Martin, E. R.; Van Lyssel, T. R. (Los Alamos Scientific Lab., N. Mex.). Sep 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

The construction and operation of the arithmetic unit developed by Group A-1 for use with the gamma enrichment meter and the neutron monitor nondestructive assay systems are described. The generic equation, $ASSAY = A \cdot C_1 - B \cdot C_2 - D$, is solved automatically on line while the data are being taken; the final answer is presented directly on LED displays; and the time of day, scalar counts, and final answer are also printed on a teletype unit. (auth)

29932 (N-73-11725) CHARGED PARTICLE TRACKS IN CELLULOSE NITRATE AND LEXAN. Interim Technical Report. Benton, E. V.; Henke, R. P. (San Francisco Univ., Calif. (USA). Dept. of Physics). Jul 1972. Contract NAS8-26758. 39p. (NASA-CR-123918; ITR-19). NTIS.

Investigations were performed aimed at developing plastic nuclear track detectors into quantitative tools for recording and measuring multicharged, heavy particles. Accurate tract etch rate measurements as a function of LET were performed for cellulose nitrate and Lexan plastic detectors. This was done using a variety of incident charged particle types and energies. The effect of aging of latent tracks in Lexan in different gaseous atmospheres was investigated. Range distributions of high energy ^{14}N particle bevatron beams in nuclear emulsion were measured. Investigation of charge resolution and Bragg peak measurements were carried out using plastic nuclear track detectors. (auth)

29933 (ORNL-TM-4316) COMMON-MODE AND INTEGRAL BIAS TESTS WITH A DIFFERENTIAL CURRENT-PULSE PREAMPLIFIER. De Lorenzo, J. T.; Clay, W. T.; Guerrant, G. C. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.

Common-mode rejection tests and integral bias measurements with a fission counter were made with a differential preamplifier to verify its superior performance as compared to a single-ended unit. The counter was constructed to provide separate signal and high voltage connections. Tests with a vacuum tester coil used as a wideband noise generator show only a slight alteration of the normal noise background curve by the differential preamplifier but a great alteration by a single-ended unit. The integral bias measurements show an improvement of signal-to-noise ratio for electronic noise by the differential operation by nearly a factor $\sqrt{2}$. (auth)

29934 (UCID-16325) REVIEW OF NEUTRON DETECTION METHODS AND INSTRUMENTS. Lorenz, A. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Sep 1973. Contract W-7405-eng-48. 53p. Dep. NTIS $4.75.

This report is an overview of neutron detection methods and neutron detector types. A brief description of the neutron-induced reactions most useful in neutron detection and a discussion of several classes of neutron detector types and their applications are included, as is an extensive bibliography. A list of commercially available neutron detectors and their characteristics is appended. (auth)

29935 (UCID-16349) RECENT DEVELOPMENTS CONCERNING BANDPASS DETECTORS. Gaines, J. L. (California Univ., Livermore. Lawrence Livermore Lab.). 11 Sep 1973. Contract W-7405-eng-48. 19p. Dep. NTIS $3.00.

Development of the passband detector consisting of a photoelectric diode with a prefilter for detecting x rays in a selected energy range of the spectrum is described. The photoelectric diode detects x-rays by measuring the secondary electron current emitted from a metal foil which exhibits jumps at the K-edge of the material and a decrease in current with increasing x-ray energy. Developments discussed include a new foil mounting method for improving the high-voltage capability and thickness optimization of the Be, Cu, and Ge window foils. (WHK)

29936 GEOMETRICAL EFFICIENCY DISTORTIONS WITH THE PIN-HOLE GAMMA CAMERA. Depresseux, J. C. (Institut de Medicine, Liege). Nucl.-Med.; 12: No. 2, 169-177(1973).

The use of a pin-hole collimator with scintillation cameras introduces an important geometrical efficiency distortion that must be taken into account in morphological and, principally, in quantitative studies. The theoretical considerations which justify the use of a bidimensional matrix of correction factors are discussed. These factors were generated within a multichannel analyzer by the treatment of the image of a homogeneous radioactive phantom detected at a long distance with adequate spectrometry. The quantitative, static or dynamic comparison between areas of image non-symmetrically distributed around the central axis of detection is thus no more a hazardous venture. (GE)

29937 COMPUTED INTRINSIC EFFICIENCIES AND MODULATION TRANSFER FUNCTIONS FOR GAMMA CAMERAS. Svedberg, J. B. (Uppsala Univ.). Phys. Med. Biol.; 18: No. 5, 658-664(Sep 1973).

For the two crystal materials, NaI(Tl) and CsI(Na), total photoelectric and photopeak efficiencies are derived at several γ-ray energies (200, 280, 360, and 511 keV) and crystal thicknesses up to 50 mm. The effects of the stochastic variations in photomultiplier pulse production and of multiple Compton events on resolution are combined in a Monte Carlo calculation so as to give the modulation transfer function of gamma cameras without collimators. The effect of a hypothetical Compton discrimination on sensitivity and resolution is discussed. (auth)

29938 SMALL CAPACITANCE RADIATION DETECTION DEVICE. Meuleman, J. (to La Radiotechnique Compelec (RTC)). French Patent 2,144,576. 6 Jul 1971. 9p. (In French).

A surface barrier or n-i-p type radiation detector having a low noise level and very little capacitance is presented. The detector consists of a semiconductor bulk having two principal parallel faces, each of these faces being provided with a contact electrode. The detector possesses at least one rectification junction on opposite sides in which electrodes are positioned. One of the

electrodes is situated on the surface of one of the principal faces, this area being bounded by a groove which is made in the bulk of the semiconductor from the principal face defining a depleted region of the junction. The groove has a trapezoidal cross section with the major base of the trapezium at the same level as one of the faces of the detector. Under these conditions, the area of the region defined by the groove is considerably reduced together with its capacity. (FR)

29939 EXCITATION CHARACTERISTICS OF CERTAIN LIGHT-PULSE SOURCES. Dragun, G. S. (Inst. of Nuclear Research, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 535-536(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 173-174(1973).

Pulsed light sources are considered from the point of view of their application for testing scintillation detectors. The characteristics were obtained from sources that were not specially designed for these purposes but are extensively used in experimental engineering. (auth)

29940 PORTABLE CESIUM COUNTER FOR FIELD USE. Wright, C. N.; Splichal, W. F. Jr. (Du Ponte de Nemours (E. I.) and Co., Aiken, SC). Health Phys.; 25: No. 5, 516-517(Nov 1973).

Details are given of a portable field monitor for the detection of ^{137}Cs in deer carcasses. The monitor consists of a shielded 2-in.-diameter by 2-in.-thick sodium iodide scintillation detector coupled to a single-channel analyzer, power supply, and timer circuit. The circuit is shown and details given. The counter is positioned over the flank of the deer and a 2 min count taken. All circuits are powered by 6.25 V obtained from rechargeable nickel-cadmium batteries, which allow an operating time of greater than 8 h. The instrument, with exception of the detector, is housed in a waterproof aluminum case with operating controls covered by a transparent plastic housing making it an all-weather monitor. (UK)

29941 HIGH EFFICIENCY DEVELOPMENT PROCEDURES FOR NUCLEAR EMULSIONS. Rechenmann, R. V.; Wittendorp, E. (Univ., Strasbourg). J. Microscopy; 96: No. 2, 227-243 (Oct 1972).

The development procedure for nuclear emulsions has been submitted to a systematic study. Each factor involved in this complex procedure has been considered separately. The optimum development time is determined by the maximum of the signal/noise ratio curve. It depends strongly on the other parameters involved in the developing process: temperature, type of emulsion, radiation, developer, etc. New treatment procedures for nuclear emulsions have been established. They are based on the following additional hypothesis concerning the corpuscular latent image: the image formed in the micro-crystals consists partly of stable sub-specks which are not developable, even by total developers. These sub-germs would render the microcrystals developable if they were "activated", i.e., if their electron levels were lowered by physical or physicochemical means. Activation by gold combined with a forced chemical development has proved to give results which are highly reproducible and homogeneous throughout the emulsion layer. Whatever the type of emulsion used and for most chemical developers, this procedure results always in a strong increase in the number of grains developed together with a remarkable stability of the chemical fog. The intensification effect increases when the grain size, the sensitivity of the emulsions, and the mean energy released in a grain by a charged particle decreases. The amplification effect becomes more important when the redox potential of the developer diminishes (in absolute value). In light and electron microscope autoradiography, the gain in efficiency resulting from these methods permits the amount of radionuclides used or the exposure times to be reduced in a ratio varying from 1 to 5 to 1 to 20, if compared with classical methods. Moreover, the increased probability of development of the "first grain hit" results in a better resolution. (auth)

29942 NUCLEAR DETECTION WITH INTEGRATED MAGNETIC RECORDING FOR MEDICAL RADIOISOTOPE APPLICATIONS. Assailly, J.; Bader, C.; Gomez, D. (Hopital Necker Enfants-Malades, Paris). Elec.-Electron. Mod.; No. 274, 30-33 (Jun 1973). (In French).

From mesucora 73 and 64. Physics exhibition; Paris, France (11 Apr 1973).

A nuclear analysis unit with integrated magnetic recording is presented. The unit is intended for medical radioisotope exploration purposes and has the advantage of being compact and easy to operate. The integrated circuit technology and the utilization of a miniature magnetic recorder led to the development of a prototype. Developments are envisaged having two or four simultaneous measurement channels, a modular structure being used for the basic functional elements. (FR)

29943 COMMENTS ON "ELASTICALLY SCATTERED RECOIL NUCLEI IN SOLID-STATE DETECTORS". Maurette, M.; Walker, R. M. (Washington Univ., St. Louis). Radiat. Eff.; 19: No. 1, 15-18(May 1973).

From international topical conference on nuclear track registration on insulating solids and applications; Clermont-Ferrand, France (May 1969).

Horn and Von Oertzen (Earth Planet. Sci. Letters; 2: 280 (1967)) have shown that tracks in mica are produced by an irradiation with 32 MeV ^{16}O ions. These tracks were attributed to K and Fe recoils produced by elastic-scattering of the incident oxygen beam. An alternate explanation of their observations is offered. The measured characteristics of the tracks are shown to be compatible with theoretical predictions for production of tracks by inelastic (mostly compound nucleus) reactions with silicon and to be inconsistent with the previously proposed elastic scattering process. The possibility that the tracks are produced by contaminant ions in the beam cannot be ruled out. (auth)

29944 OPTICAL-BINARY CODED POSITION-SENSITIVE RADIATION DETECTOR. Lee, L. Y. (To United States Atomic Energy Commission). US Patent 3,758,780. 11 Sep 1973. Filed date 8 Nov 1972. 8p.

A position-sensitive radiation detection system has been provided for use with scintillation detection mediums wherein the position of a radiation event within a block of scintillation material is determined by an optical-binary coding system such that a digital signal output is provided which is indicative of the position of a radiation event within the scintillator. The image of the scintillator is formed onto the light sensitive areas of a plurality of photomultiplier tubes by means of a corresponding plurality of lenses. A coded screen or mask is placed between each lens and its corresponding photomultiplier tube in the position of the image to obstruct a selected portion of the image from the view of each photomultiplier so that the output of each photomultiplier tube provides one digit of a multiple bit binary signal to indicate the location of the event. The first digit or least significant bit would come from a photomultiplier tube number one which would have a screen which obstructs one-half of the image so that the output would be either a binary "1" or "0" depending upon which half of the scintillator is struck by a single beam of ionized radiation to generate a light pulse with the detector medium. A second screen with two slits is placed in position of the image on a second photomultiplier tube to divide the image of the scintillator into four parts and forms the second bit of the binary signal, thereby dividing the images into four sections as would be coded at the outputs of photomultipliers one and two; and so on for additional photomultipliers. The screen may provide either rectangular or polar coordinate measurements and the outputs of the photomultipliers may be stored in a digital storage device or connected to an analog signal for oscilloscope display or other recording. (Official Gazette)

29945 DIRECTION AND INTENSITY RADIATION MONITOR. Damljanovic, D. D.; Kovac, B. J.; Djantar, K. D. (Boris Kidric Inst., Vinca, Yugoslavia). pp 639-643 of Health Inst., Vinca, Yugoslavia). pp 639-643 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A monitor containing two radiation detectors, separated by a suitably shaped shield, capable of measuring radiation intensity simultaneously with determining the direction of its steepest spatial increase (or decrease) is described. (auth)

29946 DESIGN AND CONSTRUCTION OF AN IONIZATION CHAMBER DETECTOR FOR RADIO-GAS CHROMATOGRAPHY. Arimoto, H. (Shimadzu Seisakusho Ltd., Kyoto). Jap. Anal.; 22: No. 7, 837-843(Jul 1973). (In Japanese).

An ionization chamber system that simplifies the analysis by providing simultaneous gas chromatography and continuous radioactivity analysis from which specific activity data is described. The ionization chamber was fabricated as a detector for radiogaschromatography. Characteristics of the equipment were examined. The equipment consists of the ionization chamber, thermostatic oven contained in the chamber, and the vibrating reed electrometer. Three kinds of chambers, i.e., 270 ml, 150 ml, and 70 ml, respectively, were used in the experiments. The system provides an extensive range of operating conditions. The oven temperature of the ionization chamber can range from ambient to as high as 300°C, easily accommodating high boiling compounds such as fatty acid esters, amino acid derivatives and steroids. Activities can be measured from 2 mμ curies ^{14}C (74 dps) or 10 mμ curies (370 dps) to many millicuries per component. Excellent resolution is retained by the purge system shown in the system flow passage diagram in which a purge gas is introduced

into the stream prior to its entering the ionization chamber. The purge gas flow may be varied to adjust the turnover time in the chamber. With the 270 ml chamber, the time for complete replacement of the chamber volume can be varied from approximately 1 minute to 20 minutes. The purge gas system offers an important advantage in that one may select a desirable filling gas for the chamber. The variation in specific ionization (electron volts/ion pair) and density of gases affects the amount of current and chamber efficiency respectively. By using a gas of high density having a low specific ionization (e.g., argon or argon + CH_4), the high resolution can be achieved at little or no loss in sensitivity. The high temperature ionization chamber is specially designed to retain the high sensitivity and precision of the ionization chamber method at elevated temperatures. The 270 ml volume offers the most desirable compromise in size when the properties of both ^{14}C and ^{3}H, the most common tracer isotopes, are considered. The chamber is constructed of stainless steel and is electrically insulated from the oven by insulators on the gas inlet and outlet lines. The chamber base includes a rigid line connector to an adapter assembly on which the chamber electrode mounts at one end and is connected to the electrometer input at the other. The electrometer input is thermally isolated from the oven by rigid line. The vibrating reed electrometer has the high sensitivity and stability essential for radioactivity measurements of ^{14}C and ^{3}H which involve detection of currents less than 10^{15} amperes. The input resistor of the vibrating reed electrometer is 10^{12} Ω maximum. Data are given for steroid and higher fatty acid methyl esters. (auth)

29947 UNIVERSAL DESCRIPTION OF CHARGE COLLECTION IN SEMICONDUCTOR DETECTORS. Lomashevich, S.A.; Strokan, N.B.; Tisnek, N.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.-Semicond. 6: No. 11, 1893-1895 (May 1973).

An approximate expression for the amplitude of the charge collected on the electrodes which is independent of the detector geometry is derived. (TFD)

Radiation Dosimeters

Refer also to abstract 29796.

29948 (AD-715797) NEUTRON AND GAMMA-RAY MEASUREMENTS WITH NUCLEAR TRACK DETECTORS. Final Report. Frank, A. L.; Benton, E. V. (San Francisco Univ., Calif. (USA). Dept. of Physics). 30 Nov 1970. Contract DASA01-70-C-0016. 57p. (DASA-2573). NTIS.

The replacement of activation analyses and photographic plates as the means of passive dosimetry are discussed. Whereas activated foils have a short half-life, speed of analysis is imperative and presents a problem. Furthermore, the analysis is complex and the energy dependence of the few foils available is such that abstracting spectral information is very difficult. One of the more significant new developments in the field of neutron detection has been made possible by the discovery of a new class of charged particle detectors called nuclear track detectors. The detecting principle is based on the delineation of individual paths of heavily ionizing charged particles such as fission fragments, recoil nuclei, alpha particles, and low velocity protons. Delineation is accomplished through a selective chemical attack of the narrow, radiation damaged region along the particle's trajectory. The resulting narrow channels referred to as tracks, can be enlarged to a convenient size for direct viewing with an optical microscope. Unlike photographic emulsions, track etch materials are insensitive to beta and gamma radiation and also to light. They can, therefore, be in the high gamma fields of testing environments. (auth)

29949 (AD-745188) HIGH-Z PARTICLE COSMIC-RAY EXPOSURE OF APOLLO 8-14 ASTRONAUTS. Technical Report, November 1961-December 1971. Benton, E. V.; Henke, R. P. (San Francisco Univ., Calif. (USA). Dept. of Physics). Jun 1972. Contract F29601-70-C-0077. 44p. (AFWL-TR-72-5). NTIS.

On Apollo missions, individual astronaut high Z particle exposure was measured by means of Lexan foils located in the passive dosimetry packs carried on the chest, thigh, and ankle of each astronaut. The report deals with measurements obtained on Apollo flights 8 to 14. Data are presented on the high Z track fluences, the stopping particle densities, and the particle integral LET spectra. The LET spectra, in turn, are used to calculate the fractional cell loss, FCL, of the human kidney (Tl) cells arising from the high Z particle exposure. The measurements, on subsequent missions, show a consistent and a significant increase in the observed high Z particle exposure. (auth)

29950 (CLOR-94-D) PREPARATION OF RADIOTHERMOLUMINESCENT FINGER DOSIMETER FOR BETA AND GAMMA RADIATIONS. Koczynski, A.; Wolska-Witer, M.; Musialowicz, T. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). 1973. 20p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.00.

The simple type of beta-gamma finger dosimeter has been prepared, on the base of dosimetric properties measured for various LiF detectors (in powder form, plates with teflon of various thickness and sintered discs), especially of the dependence of detector read-out upon the energy of beta radiation. The construction and parameters of dosimeter are described as well as conditions and manner of dose determination for mixed beta and gamma radiations using two sintered LiF discs. (auth)

29951 INVESTIGATIONS ON THE USE OF MALTOSE SOLUTIONS AS A ^{60}Co GAMMA RAYS DOSIMETER. Bachman, S.; Zegota, H. (Politechniki, Lodzka, Poland). Nukleonika; 18: No. 5, 203-208(1973). (In Polish).

The possibility of using 1% solutions of maltose as a dosimetric system of ^{60}Co gamma rays for irradiated food products has been investigated. For estimation of radiation dose, the measurements of linear relation of malondialdehyde or deoxysugar concentration vs. radiation dose was used. The maltose dosimeter may be applied in the dose range 0.1 to 4 Mrad. (auth)

29952 AUTOMATIC EVALUATION OF AN ABSORBED DOSE BY MEANS OF A DIFFERENTIAL PULSE SPECTRUM. Antipenkov, V. P.; Artemov, B. V.; Bregadze, Yu. I.; Ermilov, B. I.; Malyaev, P. F. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 4, 627-628(Apr 1973).

Translated from Izmer. Tekh.; 16: No. 4, 90-91(Apr 1973).

A digital dose meter for automatically evaluating the absorbed dose using proportional counters is described. (WHK)

29953 FERROUS SULPHATE DOSIMETRY FOR 14 MeV NEUTRONS. Liesem, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H.; Frankfurt am Main). Phys. Med. Biol.; 18: No. 5, 740-742(Sep 1973).

A brief note is made of the determination of the G-value at 25°C for 13.6 MeV neutrons using 10^{-3} molar $FeSO_4(NH_4)_2SO_4$ in 0.4 M sulfuric acid. A G-value of 9.7 ± 1.1 $(100\ eV)^{-1}$ was obtained. The γ-background of the neutron field was 2% and correction was made by assuming $G = 15.5 \pm 0.2\ (100\ eV)^{-1}$ for γ-rays according to ICRU recommendations (1969). The absorbed dose was corrected for the attenuation of the neutron fluence in the ferrous sulfate solution by −3.4%. (UK)

29954 MEGARAD PLASTIC FILM DOSEMETER. Richold, P. H. C. V.; Douglas, J. A.; Marshall, M.; Gibson, J. A. B. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Phys. Med. Biol.; 18: No. 5, 665-672(Sep 1973).

A simple dosemeter has been designed for the measurement of doses from 0.1 to 100 Mrad. The dosemeter is a thin film of polycarbonate (thickness 200 μm) and the response to radiation is recorded by an increase in absorbance at wavelengths of 290, 300, or 325 nm. The effect of ^{60}Co γ-radiation on the film has been measured. After an initial storage period of 10 h, the reading fades at the rate of 0.4% per week and is unaffected by extremes of temperature and humidity during storage. The precision is ±2% from 1 to 50 Mrad but doses of 0.1 Mrad and up to at least 100 Mrad can be measured. Above 37°C the dosemeter is sensitive to temperature during radiation and at dose rates below 50 krad h^{-1} there is a reduction in response by about 20%. (auth)

29955 MEASUREMENT OF HIGH γ-RADIATION DOSES USING A γ-INDUCED NUCLEAR REACTION. Ware, A. R.; Oldham, G.; Biby, D. M. (Loughborough Univ. of Tech., Eng.). Radiochem. Radioanal. Lett.; 15: No. 2, 107-115(25 Sep 1973).

The photoactivation of ^{115}In to produce ^{115m}In (T 4.5 hours, γ-radiation 0.335 MeV) was investigated and applied to the measurement of γ-radiation dose rates in the range 2.75×10^5 rad to 730 Mrad. (auth)

29956 GAMMA-RAY DOSIMETRY WITH THIN PLASTIC FILM. Yoo, Y. S.; Ro, S. G. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 3, 223-233(Sep 1973).

Thirty-two different kinds of domestic plastic films for use in measuring high gamma-ray doses have been collected and their dosimetric characteristics investigated with the help of a ^{60}Co-gamma radiation source. Among them is a rigid polyvinyl chloride(PVC) film of 0.06mm in thickness which seems to be the most suitable one for this purpose. The relation between optical density at 3100Å and radiation exposure in this PVC film was linear in the range of 0.6×10^6R to 1.3×10^7R, and also the film showed a good reproducibility within 9% under the standard experimental condition. The effect of absorbed dose, oxygen content of surrounding atmosphere and irradiation temperature have also been studied for this film. It appeared to have a good property in the dosimetric point of view. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 29906, 30501, and 30756.

29957 (CONF-710947-P2, pp 546-555) METHOD FOR DETERMINATION OF THE ABSORPTION-PROBABILITY OF MOESSBAUER QUANTA WITHOUT RECOIL. Bonchev, T.; Manushev, B. 1971. (In Russian).

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

29958 (CONF-710947-P2, pp 565-582) RESONANCE IONIZATION CHAMBERS AND THEIR APPLICATION IN GAMMA RESONANCE STUDIES. Makarov, E. F.; Zemskov, B. G.; Garzanov, I. Ya. 1971. (In Russian).

From fourth international conference of the socialist countries on Moessbauer spectrometry; Dresden, F. R. Germany (20 Sep 1971).

29959 (CONF-730301-P1, pp 227-242) HIGH RESOLUTION SPECTROMETERS. Kowalski, S. (Massachusetts Inst. of Tech., Cambridge). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Some of the major advances made during the last few years in the design and construction of high-resolution magnetic spectrographs are reviewed. Major areas discussed include optics and magnetics with emphasis on useful techniques and design principles to be followed. The importance and use of computational design tools is pointed out together with conventional and new techniques for minimizing hysteresis and eddy current effects in dipole magnets. Several examples of high-precision spectrometer designs currently in use or under construction at a variety of nuclear structure laboratories are discussed. These include both conventional and energy loss types. (auth)

29960 (CONF-730301-P1, pp 253-254) PROMPT AND DELAYED NEUTRONS FROM PHOTOREACTIONS. Part I. The LASL High Efficiency Neutron Detector and Multiplicity Sorter. Dowdy, E. J.; Worth, G. M.; Caldwell, J. T. (Los Alamos Scientific Lab., NM). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

In order to make measurements of the yields (and energy dependence of the yields) of prompt and delayed neutrons and the multiplicity distributions of the prompt neutrons from photofission in ^{232}Th, ^{238}U, ^{235}U, and ^{239}Pu, a 4π neutron detector was constructed. The detector has high intrinsic efficiency and relative insensitivity to ambient and induced gamma radiation. The detector is described, and a block diagram of the experimental setup is shown. (LTW)

29961 (CONF-730301-P1, pp 265-266) SEMICONDUCTOR COUNTER TELESCOPE FOR THE MEASUREMENT OF PHOTOPROTON ENERGY SPECTRA. Hemmer, C.; Stock, R.; Wienhard, K.; Wolf, H. (Univ., Giessen, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A facility for the measurement of photoproton spectra at the bremsstrahlung beam of the Giessen 65-MeV electron linear accelerator is described. The main difficulties in measuring charged photoparticles with a pulsed γ-beam are due to a high background of low energy electrons producing pile-up effects. To avoid these difficulties a telescope consisting of three silicon surface barrier detectors was used. The first two detectors of thickness 60μ and 1600μ, respectively, are operating in coincidence, representing the usual dE/dx-E arrangement. The third detector works in anticoincidence in order to eliminate ΔE-pulses from high energy particles. A block diagram of the electronics is shown. Current sensitive preamplifiers are used instead of the usual charge sensitive preamplifiers. The output signals of these preamplifiers are short enough (70 nsec) to permit the measurement of photoproton spectra in the presence of a high electron background. To test the operation of the telescope, photoproton spectra from ^{16}O were measured with a bremsstrahlung end-point energy of 30 MeV. (LTW)

29962 (CONF-730301-P1, pp 271-272) MEASUREMENT OF THE RESPONSE OF A LARGE NaI(Tl) SCINTILLATOR TO HIGH ENERGY PHOTONS. Bramblett, R. L.; Fultz, S. C.; Berman, B. L.; Kelly, M. A.; Caldwell, J. T.; Sutton, D. C. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Typical response functions for a large NaI(Tl) scintillator are shown after correction for random coincidences. (LTW)

29963 (INP-836) AUTOMATIC UNIT FOR KD SOG-1 NEUTRON SPECTROMETER CONTROL. Bajorek, A.; Brankowski, J.; Olejarczyk, W.; Ostrowicz, A.; Sokolowski, J.; Starzewski, J.; Sciesinski, J.; Zaleski, T. (Institute of Nuclear Physics, Krakow (Poland)). May 1973. 54p. (In Polish). Dep. NTIS (U.S. Sales Only) $4.75.

Control devices for the KD SOG-1 neutron spectrometer are described in this paper, with special regard to the unit controlling its kinematics. The logical structure and the cooperation of the individual blocks, as well as the possible variants of operation of the whole unit, are presented. (auth)

29964 (ITEF-938) ELECTRON ENERGY MEASUREMENT IN XENON BUBBLE CHAMBER BY SHOWER TRACKS TOTAL LENGTH METHOD. Barmin, V. V.; Barylov, V. G.; Golubchikov, V. M.; Gorokhov, A. I.; Demidov, V. S.; Konoplev, N. S.; Shebanov, V. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1972. 16p. (In Russian). INIS.

By means of the ITEF 180-liter xenon chamber the possibility of measuring the energy of electrons by the method of the total length of the shower tracks was studied in the energy range from 0.1 to 2.3 GeV. In this interval the total shower track depends linearly on the energy. The precision of the measurement of the electron energy is 20% at 0.1 GeV and about 10% in the interval from 1 to 2.3 GeV. The effect of the finite dimensions of the chamber on the measurement of the electron energy by this method was examined. (tr-auth)

29965 ANALYZER FOR MEASURING X-RADIATION. Anisovich, K. V.; Goganov, D. A.; Komyak, N. I. British Patent 1,323,238. 11 Jul 1973. Filed date 16 Aug 1971. 7p.

An analyser is described for measuring x radiation in a preselected range of energies, comprising a filter having an absorption edge energy corresponding to the upper limit of the preselected energy range, a radiator located behind the filter, along the radiation path, having an absorption edge energy corresponding to the lower limit of the selected energy range, and a detector responding to the radiation from this radiator. An additional radiator is located behind the main radiator, along the radiation path, having an absorption energy edge not lower than that of the filter, together with an additional detector that responds to the radiation from the additional radiator in such a way that a difference signal, indicative of the intensity of the x rays being measured, is set up across the analyzer output. The filter may consist of two laminations, the first incorporating a material having an absorption K-edge corresponding to the upper limit of the selected energy range, while the second incorporates a material having an absorption L-edge lying between this K-edge of absorption and the K-edge of a material having an atomic number lower than that of the material of the first lamination. Such an arrangement provides for a decrease in the sensitivity threshold and an increase in accuracy of the x ray measurements. (UK)

29966 ULTRAMINIATURE X-RAY FLUORESCENCE SPECTROMETER FOR IN-SITU GEOCHEMICAL ANALYSIS ON MARS. Clark, B. C. (Martin-Marietta Corp., Denver); Baird, A. K. Earth Planet. Sci. Lett.; 19: No. 3, 359-368(Jul 1973).

Determination of the surface composition at various sites on the planet Mars will provide information essential to a better understanding of the geologic history of this complex planet. A spectrometer based upon the x-ray fluorescence method of elemental analysis has been developed in an ultraminiature, rugged form suitable for a spacecraft mission to Mars. The instrument employs two radioisotope sources (^{55}Fe and ^{109}Cd) which irradiate adjacent areas on a regolith sample. Fluorescent x-rays emitted by the sample are detected by four thin-window proportional counters. Using pulse-height discrimination, the energy spectra are determined. Virtually all elements above sodium in the periodic table are detected if present at sufficient levels. Minimum detection limits range from 30 ppm to 2%, depending upon the element and the matrix. For most elements, they are below 0.5%. Accuracies also depend upon the matrix, but are generally better than $\pm 0.5\%$ for all elements of atomic number greater than 14. Elements below sodium are also detected, but as a single group. Ambiguities of identification of the elements producing the observed spectra are minimal. Exotic geological materials are, therefore, just as susceptible to analysis as are the more common rocks. A computer model of the instrument has been developed and tested. This model was used to optimize instrument parameters during the design phase, and has now been expanded to perform automatic analysis of the output data. (auth)

29967 THREE-CRYSTAL X-RAY POLARIMETER, COLLIMATOR, AND SPECTROMETER. Hrdy, J.; Krousky, E. (Inst.

of Solid State Physics, Prague). Czech. J. Phys.; 23: No. 9, 966-972(1973).

The properties of the three-crystal devices with the third crystal in "crossed position" and "partly crossed position" are discussed. The term "crossed position" was introduced to designate such arrangement which may be derived from the triple-crystal diffractometer by rotation of the third crystal about the incident central beam through a certain angle ω. The properties of these devices when used as an x-ray polarimeter, collimator, and spectrometer are analyzed. (auth)

29968 DOUBLE RADIATION DETECTOR. Meuleman, J. (to La Radiotechnique Compelec (RTC)). French Patent 2,145,372. 9 Jul 1971. 6p. (In French).

A semiconductor detector device for γ-ray spectrometry is presented in which the Compton scattering peak is almost eliminated. The device is provided with two n-i-p type semiconductor detectors, one of which is the envelope of the other. Both the detectors are formed in a single semiconductor block and present well type configurations. The semiconductor block is cylindrical and the two detectors coaxial. The accurate control of the depth of diffusion ensures that the two detectors have very similar characteristics. They are separated by a very thin inactive layer. In this way, the parasitic absorption of photons is reduced. The initial semiconductor material of the block is p-type germanium, the n-type intrinsic regions being obtained by depositing lithium. (FR)

29969 X-RAY FLUORESCENCE SPECTROMETER AND RADIOACTIVITY COUNTING STABILITY: LIMITS OF DETECTION WITH RESIN-LOADED PAPERS. Hooton, K. A. H. Tempe, AZ; Arizona State Univ. (1973). 85p. University Microfilms Order No. 73-20,430.

Thesis (Ph. D.).

Unstable conditions in the component units of x-ray fluorescence spectrometers and radioactivity counting equipment can result in serious errors of analysis. The mean square successive difference (MSSD) method is introduced for the first time to reveal drift or oscillations. Drift and large oscillations present together can be detected by new statistics developed from the MSSD method. The chi-squared test, analogous to its use in radioactivity counting, has been adopted for x-ray fluorescence spectrometer stability testing. These methods are more sensitive than the present criterion for acceptable equipment stability in which the set of observed replicate counts is expected to lie within the range of $\pm 3\sigma$ about the mean. The combined statistical tests are applied expeditiously by means of a desk calculator. The use of ion-exchange resin-loaded paper disks as a concentration step preceding quantitative analysis by neutron activation or x-ray fluorescence spectrometry involves multiple filtration through the paper disks for complete ion exchange. Traditionally this filtration has been unidirectional but, because of the nature of the ion-exchange resin-loaded disk, repeated filtrations can be performed through the disk in one direction and back through in the reverse direction until ion exchange is complete. A filter unit is described which was fabricated and used to make use of this principle. Retention of some cations and anions on ion exchange resin-loaded disks has been reported to be less than quantitative. A mixed-bed resin-loaded paper was made in which mixed cation-exchange and anion-exchange resins were incorporated into the paper to take advantage of the crossed equilibria effect and improve ion retention. Also, in a preliminary study with mixed-bed and SA-2 cation-exchange resin-loaded disks, analyses for Co, Zn, and Pb in amounts approaching the theoretical limits of detection were attempted. Based on the results, the definition of limit of detection which requires a line intensity above background equal to three times the square root of the background, using a 10-minute count, was modified to the line intensity above background equal to three times the standard deviation of the background counted for 10 minutes on a series of blank disks. Chemical precleaning of the disks and corrections for paper density were shown to be advantageous for work close to the limit of detection. (Diss. Abstr. Int. B.)

29970 FIELD PULSE-HEIGHT ANALYZER (28 JUN 1973) (ENGINEERING MATERIALS). (Los Alamos Scientific Lab., N. Mex.). (Cape-2361).

12 drawings.

A portable nuclear radiation spectrometer was designed for rapid field measurement of mixed isotopic contaminants. The instrument can simultaneously accumulate counts in six energy channels. The first application of the spectrometer used a low energy photon scintillation detector, but the instrument can be adapted to other types of detector probes. (auth)

29971 KP303 FIELD-EFFECT TRANSISTOR IN A SOFT-GAMMA RADIATION SPECTROMETER. Tret'yakov, V. A.; Popeko, L. A.; Pavlova, T. I.; Afanas'eva, N. P. (Leningrad Inst. of Nuclear Physics). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 518-520(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 159-160(1973).

A spectrometer is described for soft γ radiation, which has a cooled KP303 field-effect transistor that is used in the capacity of an input active element of the low-noise preamplifier. The energy resolution with a Si(Li)-detector is 515 eV with respect to the 13.96 keV line, while it is 420 eV with respect to the generator. The construction is given for placing the field-effect transistor into the cryostat together with the detector. The dependence of the energy resolution on the time constants of the shaping filter is presented. (auth)

29972 PARAMETERS AND ENERGY RESOLUTION OF KP303 FIELD-EFFECT TRANSISTORS AT LOW TEMPERATURES. Tret'yakov, V. A.; Pavlova, T. I. (Leningrad Inst. of Nuclear Physics). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 515-517(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 156-158(1973).

The following dependences of the parameters of KP303 field-effect transistors for spectrometers were investigated at low temperatures: (a) the gate current as a function of temperature and gate-sink voltage; and (b) the dependence of the transconductance on temperature and gate-source voltage. It was established that during cooling the gate current decreases by three orders of magnitude in the investigated field-effect transistors, while the transconductance increases by an average of a factor of 1.7. Comparative data are presented on the energy resolution of field-effect transistors at room temperature and at low temperatures. (auth)

29973 IMPROVED PROTON RECOIL TELESCOPE DETECTOR FOR FAST NEUTRON SPECTROSCOPY. Chung, M. K. (Atomic Energy Research Inst., Seoul); Kang, H. D.; Park, T. S. J. Korean Nucl. Soc.; 5: No. 3, 191-201(Sep 1973).

For fast neutron spectroscopy in MeV region, a recoil proton telescope detector was designed and constructed so as to increase in detection efficiency without appreciable deterioration in energy resolution by adopting a special type of recoil proton radiator which is a combination of a ring-shaped vertical radiator and a cone-shaped horizontal radiator at a certain geometry. A neutron stopper was built in the detector system to minimize the background due to direct exposure of the Si(Li) detectors to primary incident neutrons. The detection efficiency and the energy resolution calculated at various neutron energies and geometries are given and these characteristics of the detector system were tested using 14.1 MeV neutrons. As the calculation predicted, the relative detection efficiency in case of the combined radiator system is almost 2.2 times that of a single, ring-shaped vertical radiator system. The calculated energy resolution is 3.7% FWHM, whereas the measured resolution was 3.9% which means resolution broadening of approximately 30% was resulted by introducing a combined radiator system into the telescope. Increase in background less than 40% was also observed. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 31126 and 31479.

29974 (DESY-73/31) BUBBLE CREATION BY ELECTRONS FROM TRITIUM DECAY IN A HYDROGEN BUBBLE CHAMBER. Horlitz, G.; Wolff, S.; Harigel, G. (Deutsches Elektronen Synchrotron (DESY), Hamburg (F. R. Germany)). Jul 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The probability of bubble nucleation in tritium decay from tritium impurities in liquid hydrogen is a linear function of the dynamic pressure at constant temperature. This behavior is similar to that of the bubble density measured in tracks of ionizing particles. The probability increases with decreasing pressure at constant temperature and with increasing temperature at constant pressure. In the region where the linear dependence of bubble density on pressure is also valid in deuterium the probability can be calculated for this liquid also. The results can be used for the determination of bubble densities in any chamber. (GE)

29975 (IFVE-SVM-72-108) RECONSTRUCTION OF PARTICLE TRAJECTORY PARAMETERS IN TRACK DETECTOR WITH MODERATING MATERIAL PLATES. Zhigunov, V. P.; Nikitin, S. G.; Spiridonov, A. A. (Gosudarstvennyj Komitet po Ispol' zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1972. 28p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.50.

Functionals to define the particle trajectory parameters in non-magnetic track detectors (such as spark and streamer chambers) with moderating material plates are derived. The functional is constructed with due regard for measuring errors and multiple coulomb scattering. (auth)

29976 A SEARCH FOR LASER-AMPLIFIED COSMIC RAY TRACKS. Morrison, R.W.; Swail, C. (Physics Department, Carleton

University, Ottawa, Canada); Dubal, L. Appl. Phys. Lett. 23: No. 3, 164-165 (1 Aug 1973).

An attempt was made to detect cosmic ray tracks using a pulsed TEA CO_2 laser. Within 4 μsec of the passage of a cosmic ray through a pressurized cell, a laser beam of 4 J/cm² energy density at 10.6 μ was fired. Pure argon and argon–krypton mixtures were studied at pressures up to 12 atm. Spots of light were seen but no tracks. Laser damage to the cell windows was the limiting factor. An alternative detector using an initial high-voltage pulse followed by a laser pulse is proposed. (auth)

Radiometric Instruments

Refer also to abstract 29906.

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 30670 and 30671.

29977 (HMI-B-126) STRUCTURAL RESEARCH AND IRRADIATION TESTS IN THE HAHN-MEITNER-INSTITUT BERLIN. Braeunig, D.; Kaempf, U.; Spencker, A.; Wagemann, H. G. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Apr 1973. 68p. (In German). Dep. NTIS (U.S. Sales Only) $5.50.

Separate abstracts were prepared for 4 of the 5 papers presented. The remaining paper was not considered to be in scope for NSA. (TFD)

For abstracts of individual papers see: 29978 through 29981.

29978 (HMI-B-126, pp 1-14) BEHAVIOUR OF THE RADIATION RESISTANCE OF COMPLEMENTARY MOS LOGIC COMPONENTS. Braeunig, D.; Wagemann, H. G.; Spencker, A. Apr 1973. (In German).

In structural research and irradiation tests in the Hahn-Meitner-Institut, Berlin.

Property changes of MOS logic circuits of German origin after irradiation with 150-keV x rays and 1.5-MeV electrons are discussed on the basis of the characteristics. The results show the strong influence of the input voltage during the irradiation on the threshold voltage. (INIS)

29979 (HMI-B-126, pp 15-27) PHASE BOUNDARY CHARGE Q_{ox} AND DENSITY OF THE PHASE BOUNDARY STATES N_{SS} OF THERMALLY OXIDIZED SILICON BEFORE AND AFTER IONIZING IRRADIATION. Kaempf, U.; Wagemann, H. G. Apr 1973. (In German).

In structural research and irradiation tests in the Hahn-Meitner-Institut, Berlin.

300 varactors of the p- and n-type have been prepared and tempered under different conditions. After the determination of Q_{ox} and N_{SS}, these varactors were irradiated with 10^4 rad of 150-keV x radiation under direct current voltage. A proportionality was found between Q_{ox} and N_{SS} in the oxidation triangle before and after irradiation as well as regarding the dependence on the applied direct voltage during the irradiation. (INIS)

29980 (HMI-B-126, pp 29-40) RADIATION RESISTANCE OF OPTICALLY COUPLED GaAs LUMINESCENCE DIODES AND Si PHOTOTRANSISTORS. Spencker, A.; Braeunig, D.; Wagemann, H. G. Apr 1973. (In German).

In structural research and irradiation tests in the Hahn-Meitner-Institut, Berlin.

Electronic components for the communication satellite "Symphonie" have been investigated. The collector current of the phototransistors which were illuminated by the luminescence diodes, decreased after a fluence of 2×10^{12} e/cm² (1.5 MeV), to 40% of the value of the non-irradiated combination. The low radiation resistance is a consequence of the series connections of a volume-sensitive component with a strongly surface sensitive one. This is discussed using electrical characteristics before and after a step-wise electron irradiation (forward current and light efficiency of the luminescence diodes, collector light current of the transistors versus light efficiency input). (INIS)

29981 (HMI-B-126, pp 41-52) RADIATION PRESELECTION OF ELECTRONIC COMPONENTS FOR SATELLITE FLIGHTS. Wagemann, H. G.; Spencker, A.; Braeunig, D. Apr 1973. (In German).

In structural research and irradiation tests in the Hahn-Meitner-Institut, Berlin.

Irradiation tests of semiconductor components of the communication satellite "Symphonie" show an anomalously strong susceptibility to ionizing radiations, which could be a hazard to the satellite mission. This defect is due to instabilities of the semiconductor surfaces, and is hardly recognizable on the non-irradiated component. As these changes can be reversibly recovered by irradiation with ^{60}Co γ radiation within the operational temperatures of the component ($T \gtrsim 150°C$), a radiation preselection of those components which are not suitable for the mission is possible. This is demonstrated for a high-voltage diode. (INIS)

29982 EFFECT OF IONIZING RADIATION ON MIS COMPONENTS. Wagemann, H. G.; Braeunig, D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). NTZ-Nachrtech. Z.; 25: No. 6, 254-260(1973). (In German).

Characteristics of varactors, transistors, and complementary switching circuits of the inverter type after irradiation with 1.5 MeV electrons in dependence on the radiation dose are graphically presented. The observed changes of the electrical properties are attributed to one common origin: change or shift of the threshold voltage. Measures for the increase of the coating layer resistance to ionizing radiation, e.g., radiation hardening, temperature annealing, are briefly described. (GE)

29983 RADIATION EFFECTS ON SYNTHETIC CABLE INSULATING MATERIALS. Van de Voorde, M. (European Organization for Nuclear Research, Geneva). Ind. At. Spatiales; 17: No. 3, 43-56(May 1973). (In French and English).

The effects of nuclear radiation on the mechanical and electrical properties of cable insulators are discussed. The damage caused by irradiation of insulators in particle accelerators is described. Some methods to improve the resistance of the insulators to radiation damage are given. (FR)

Miscellaneous Instruments

Refer also to abstracts 29784, 29804, 29805, 31299, 31784, 31865, 31866, 31909, 31915, 32151, 32171, 32187, 32196, and 32206.

29984 (CONF-720823-P1, pp 281-290) CONTINUOUS FLOW SINGLE PARTICLE CONDENSATION NUCLEI COUNTER. Lieberman, A.; Ogle, H. M.; Falkner, C. (Royco Instruments, Inc., Menlo Park, CA). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

A combination of an optical single particle counter with a continuous flow cloud chamber is being investigated as a sub-micron particle analyzer. The flow, temperature, and pressure characteristics necessary to maintain nuclei activation and particle growth have been explored with various vapors. The conditions necessary to grow and detect individual particles in the 0.01 micron size range have been explored. Some of the limitations and potentials of this technique are presented. (auth)

29985 (CONF-720823-P1, pp 291-310) MONITORING AEROSOL CONCENTRATIONS WITH PIEZOELECTRIC CRYSTALS. Brenchley, D. L. (Purdue Univ., Lafayette, IN); Carpenter, T. E. Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

Piezoelectric crystals are an accurate method for measuring mass. Thus aerosols which are deposited on such a crystal can be quickly and accurately detected. The theory and application of piezoelectric crystals for monitoring aerosol concentrations are discussed and a current literature review is given. A piezoelectric crystal will mechanically vibrate when placed in an oscillating field, as is the case when it is made part of an electrical driving circuit. If the electric field of the driving circuit oscillates at a frequency fairly close to the resonant frequency of the mechanical vibration of the crystal, it forces the entire circuit to oscillate at that frequency. The natural frequency of the crystal depends on the mass of the crystal and any material which is attached rigidly to its surface. This property leads to the possiblity of using the crystal to monitor increments of mass added to its surface. The natural frequency of oscillation of the crystal decreases in direct proportion to the amount of added mass. Presently there are two commercially available piezoelectric particle mass monitors. One uses an electrostatic precipitator type collector while the other uses a single stage inertial impactor. Both units have been tested for use in ambient and source monitoring of aerosols. The piezoelectric crystal was adapted for use in conjunction with a cascade impactor. The result is a four-stage piezoelectric cascade impactor. The impactor design is similar to that of the Battelle impactor. The mass sensor system consists of one crystal at each stage and one reference crystal. The signals of the monitoring crystal

and the reference crystal are mixed and the difference frequency obtained. In this way, ambient effects such as temperature changes were substracted out and only changes due to mass were detected. The results obtained from this study indicate that this type instrument can be used to accurately and quickly determine the particle size of ambient concentrations. With certain modifications, it might also be used for source monitoring. (auth)

29986 (ITEF-908) STUDY OF WIRE MAGNETOSTRICTIVE SPARK CHAMBER MODEL IN ITEF 3m MAGNETIC SPECTROMETER. Dzhelyadin, R. I.; Kushkurno, V. V.; Krutenkova, A. P.; Kulikov, V. V.; Fedorets, V. S. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi I Eksperimental'Noi Fiziki). 1971. 8p. (In Russian). INIS.

The performance of the magnetostrictive lines of data retrieval with the wire spark chamber and the ferrite ring in the magnetic spectrometer ITEF were examined. The setting of the magnetostrictive lines in the slit in the upper sectional yoke of the magnet does not lead to appreciable deterioration of the performance of the lines during switching on of the field. The dimension (100×65 cm^2) necessary for operation in the magnetic field as a rule insignificantly exceeds the useful surface (100×50 cm^2). For data retrieval systems in the ferrite ring of the yoke, satisfactory screening of the magnetic field is not guaranteed. The performance of the ferrite ring in any position with respect to the field is possible only at distances of ~ 2 m from the magnet gap. (tr-auth)

29987 (NIIAR-P-167) ATTACHMENT TO A MASS SPECTROMETER FOR HIGH-TEMPERATURE HETEROGENEOUS REACTION INVESTIGATIONS WITH CHEMICALLY ACTIVE GASES. Prokop'ev, V. M.; Boiko, O. S.; Kalygin, V. V. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 15p. (In Russian). INIS.

An attachment to the MV-2302 mass spectrometer for investigating the region of high temperatures (up to 1400°K) of heterogeneous reactions with the participation of chemically active chlorine-containing gases is described. Results obtained with it by means of experiments according to chemical technology of the electromagnetic method of the separation of isotopes are reported. The attachment can be manufactured by scientific laboratories and used on mass spectrometers of other types. (tr-auth)

29988 (SGAE-2134) MODULAR INSTRUMENTATION IN NUCLEAR ELECTRONICS: INTRODUCTION TO CAMAC. Attwenger, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Elektronikinstitut). May 1973. 29p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

The international standardized CAMAC-system, an interface system for computer controlled processes and experiments, is described. The important specifications are described. (auth)

29989 (UCRL-74717) QUANTITATIVE NONDISPERSIVE X-RAY FLUORESCENCE ANALYSIS OF HIGHLY RADIOACTIVE SAMPLES FOR URANIUM AND PLUTONIUM CONCENTRATION. Pickles, W. L.; Cate, J. L. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 14 Aug 1973. 12p. (CONF-730830-2). Dep. NTIS $4.00.

From 22nd conference on applications of x-ray analysis; Denver, CO (22 Aug 1973).

Fluorescent x-ray energy spectra were successfully acquired from uranium and plutonium in 400:1 ratios in samples containing 2 Ci/gram of mixed fission products. The analytical system consists of a silver transmission anode x-ray tube, a low-Z scattering chamber, a magnetic β-ray trap, a beam monitor probe, a commercial Si(Li) detector, a set of modified electronics to handle the large γ-ray overload rate, and a computer analyzer using a higher-level language to handle data reduction. The computer programs used to obtain peak areas from the closely spaced uranium and plutonium ($L\alpha$ 1 + 2) peaks were constructed to make use of knowledge of upper-edge tailing gained in this experiment. Programs are being developed to properly remove background under the uranium and plutonium peaks. Absorption effects in the larger samples have been measured using the ratio of uranium (Ll) to uranium ($L\gamma$) peak area and are incorporated in the data-analysis schemes. A titanium monitor probe, consisting of a fixed titanium plate near the sample, introduces a constant-area titanium K x-ray line into the spectrum. The program uses the area of this peak to correct for effects of total exciting flux, geometry, and system dead-time losses. Standard samples of various types are used to generate calibration curves from which quantitative results are obtained. Samples are taken from dissolved high-burnup power-reactor fuel rods. The liquid sample is acidic and has a radiation level at one foot of approximately 2 R/hr β and 300 mR/hr γ. Sample preparation involves only the evaporation of the liquid sample on a ½-mil polycarbonate substrate and subsequent sealing with another layer of polycarbonate film. The samples are then mounted in standard 35-mm slide-holders. Preliminary testing on a limited number of prepared uranium and plutonium samples indicates a precision of about 1% and an accuracy of about 2%, over a range of 1 to 58 μg total mass. The samples have not yet been verified by independent chemical analysis. The system has been installed at the AEC Savannah River facility for extensive testing. (auth)

29990 PEAK VOLTMETER FOR SINGLE NANOSECOND PULSES. Vlasenko, S. I. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 465-466(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 116-117(1973).

A peak voltmeter is described that is designed for determining the amplitude of single pulses having a length >20 nsec from a high-current electron accelerator. Simultaneous recording of two pulses of either polarity is possible. The pulse-amplitude memorization time is ~1 min for an accuracy of 3%. The schematic and amplitude characteristics are presented. (auth)

29991 MASS SPECTROMETRY OF URANIUM AND PLUTONIUM ISOTOPIC ANALYSIS USED TOGETHER WITH A MINI-COMPUTER. Sato, H.; Asakura, Y.; Kagami, K.; Kamata, M. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). Shitsuryo Bunseki; 21: No. 2, 187-193(Jun 1973).

A mini-computer system specifically designed for a surface ionization instrument capable of precise isotopic abundance measurements of uranium and plutonium is described. The mini-computer system has two major functions; it is possible to reduce the analytical error and personal errors in measuring the peak height with tools. The system consists of five parts; Analog-Digital-Converter (A. D. C.), mini-computer (4k), teletype, and two mass spectrometers. The data consist of the A. D. C. voltage level from a vibrating reed electrometer which was connected to the ion beam detector within a mass spectrometer. The voltage level is converted to a digital form by means of a voltage-to-frequency converter (VTFC) and a number of four figure scalers. This output is fed into a scaler gated for a predetermined time. The counts in the scaler are then proportional to the voltage level for any given gate time and are read directly into the computer. The gate time for counting the frequency is 0.4 sec and is controlled by the computer. To reduce the measuring error due to noise, the computer calculates the average of three values of before and behind of the actual highest value for the highest value of a peak. When the period between the times measured for the starting value (i.e., the differential value of the frequency of VTFC which changed from zero to plus) and the end value (i.e., the differential value of the frequency of VTFC which changed from minus to zero) of a peak is shorter than the established one, the computer does not detect it as a peak. (auth)

29992 MASS SPECTROMETRIC METHOD FOR STUDYING CHARGE TRANSFER REACTIONS. Rosenberg, A.; Bregman-Reisler, H.; Amiel, S. (Soreq Nuclear Research Centre, Yavne, Israel). J. Mass Spectrom. Ion Phys.; 11: No. 5, 433-443(Jul 1973).

A modified single stage mass spectrometer for studying charge transfer reactions is described. The energies of the ionizing electrons and of the primary ions can be controlled independently. The electron energy (range: 10 to 70 eV) has a spread of less than 1 eV and that of the primary ions (range: 20 to 150 eV) less than 2 eV. The apparatus can measure simultaneously the primary and secondary ion currents. The cross sections obtained are in agreement with those obtained with single and tandem mass spectrometers. The apparatus was used for determinations of cross sections and break-down spectra as functions of the energies of the primary ions or of the ionizing electrons. (auth)

29993 AN INSTRUMENT FOR REAL-TIME DETERMINATION OF POLAR ELECTROJET POSITION AND CURRENT PARAMETERS. Sellers, B.; Hanser, F.A. (Panametrics, Inc., 221 Crescent Street, Waltham, Massachusetts 02154); Vancour, R.P. Rev. Sci. Instrum. 44: No. 7, 888-889 (July 1973).

A portable instrument for on-site determination of polar electrojet position and intensity has been assembled and used during auroral magnetic disturbances at Ft. Churchill, Canada. The instrument provided data for determination of optimum launch time for rockets used to study auroral phenomena associated with the disturbances. (auth)

29994 LOW COST BEAM CURRENT INTEGRATOR. Carra, W.M.; Ehret, J.E. (Aerospace Research Laboratories, Wright-Patterson Air Force Base, Ohio 45433); Meese, J.M. Rev. Sci. Instrum. 44: No. 7, 835-836 (July 1973).

An inexpensive beam current integration system is described which measures the total integrated charge in a direct current accelerator beam during electron damage or ion implantation experiments over a wide range of positive or negative beam currents used in these experiments. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 30471, and 32177–32179.

29995 (AAEC/E-261) TWIST: A NUMERICAL TECHNIQUE FOR CALCULATING THE STEADY-STATE MASS FRACTION VARIATION IN AN AXI-SYMMETRIC BINARY GAS MIXTURE SUBJECTED TO PRESSURE GRADIENTS. Spinks, N.; Wilson, D. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1973. 48p. Dep. NTIS (U.S. Sales Only) $4.50.

The equation for diffusion in a binary gas mixture is integrated over each of a number of elements into which the R-Z system volume is divided. The resulting equations are soluble using the TWIST programme to give the mass fraction variation through the system. The programme is suitable for analysis of any device which utilizes pressure diffusion for the separation of a binary gas mixture, the components of which have approximately equal molecular weights and is describable in the R-Z coordinate system. Applications include the centrifuge, the vortex tube, and the vortex matrix. A knowledge of the mixture mass flow and pressure distribution throughout the system is assumed. A weakness of this method is the requirement of a fine subdivision of the system volume when such flows are large. The TWIST programme has been applied to a countercurrent centrifuge and the results compared with those from Cohen's theory. (auth)

29996 PROCESS DESIGN CONSIDERATIONS AND STEADY-STATE OPERATIONAL DATA FOR THE SEPARATIONS OF ISOTOPES OF OXYGEN. Wolf, D.; Cohen, H. (Weizmann Inst. of Science, Rehovot, Israel). Can. J. Chem. Eng.; 50: No. 5, 561-684(1972).

Operational data for the separation of oxygen isotopes are given on flow rates, concentrations and concentration profiles of the isotope separation plant of the Weizmann Institute of Science which has reached steady-state operational conditions with regard to the rare and more difficult to separate ^{17}O isotope. This plant consists of two sections, namely packed distillation columns and thermal diffusion columns. Data on the columns and packing characteristics are given. The concentrations reached in the distillation section are up to 98% of ^{18}O and up to 20% of ^{17}O. In the thermal diffusion section, considerations of ^{18}O up to 99.9% and of ^{17}O up to 96% have been attained. (auth)

29997 ELECTROMAGNETIC SEPARATION OF ISOTOPES AT OAK RIDGE. Love, L. O. (Oak Ridge National Lab., TN). Science; 182: No. 4110, 343-352(26 Oct 1973).

The 30-year history of work at Oak Ridge on the electromagnetic separation of isotopes is reviewed in detail, and the present system is described. (LCL)

Isotopic Power Sources

Refer also to abstract 29791.

29998 FUEL CAPSULE VENT SYSTEM DEVELOPMENT FOR THE VIKING RADIOISOTOPE THERMOELECTRIC GENERATOR. Schumann, F. A. (Teledyne Isotopes, Timonium, MD). Contract AT(29-2)-2960. Nucl. Technol.; 19: No. 3, 156-164(Sep 1973).

A fuel capsule vent system was developed and designed for the radioisotope thermoelectric generator (RTG) in support of the upcoming Viking mission to Mars. Helium is continuously produced within the fuel capsule as a result of isotopic decay. By venting the helium external to the RTG, the initial RTG fill gas is maintained for maximum thermal efficiency. This reduces degradation of thermoelectric converter performance and provides the maximum electrical power for the mission. The logic and analysis, which led to the selection of a closed helium storage system, are described. (auth)

Radiation Sources

Refer also to abstracts 30387, 30712, and 31750.

29999 NEUTRON YIELD FROM A SMALL HIGH PURITY $^{238}PuO_2$ SOURCE. Bair, J. K.; Butler, H. M. (Oak Ridge National Lab., TN). Nucl. Technol.; 19: No. 3, 202-203(Sep 1973).

The neutron yield from a small high purity $^{238}PuO_2$ source has been measured to be 1.705×10^4 n/sec per gram of ^{238}Pu with an accuracy of better than 1%. (auth)

Design and Fabrication

Refer also to abstract 31861.

Industrial Uses

Refer also to abstracts 29810 and 30057.

30000 (AD-748405) RADIATION DOSIMETRY AT CRYOGENIC TEMPERATURES USING THERMOLUMINESCENCE. Jarrett, R. D.; Halliday, J. W.; Tocci, J. (Army Electronics Command, Fort Monmouth, N. J. (USA). Night Vision Lab.). Jan 1972. 22p. (FL-147; USA-NLABS-TR-72-36-FL). NTIS.

Organoleptic testing of radiopreserved foods has shown that acceptability is highly correlatable with irradiation temperature. In general, irradiation temperatures in the region of −30°C yield the most acceptable product. Thus, a requirement has been generated, particularly in commercial applications, for a dosimeter capable of being used in radiation field mapping and production dose monitoring at these temperatures. Of the various dosimetry systems considered for this application a thermoluminescent system shows the most promise. Samples of the commercially available materials were subjected to a screening and evaluation procedure to determine their applicability. The results of this study are discussed including calibration data for these thermoluminescent materials for electron and gamma irradiation at various temperatures. (auth)

30001 (EURISOTOP-82) RADIOMETRY. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Jul 1973. 322p. (In Several Languages). Dep. NTIS (U.S. Sales Only) $18.25.

A systematic summary is presented of the non-technical conditions imposed in countries of the European Community on industrial uses of radioisotopes and informs users of the different regulatory, national, and international conditions. These include regulations on the storage, transport, and national and international exchange of radioactive sources; prevention and indemnification of damages caused by ionizing radiation; and information on the elementary precautions to be taken for prevention of damage and injuries. (tr-auth)

30002 FOOD IRRADIATION USING ACCELERATORS. Sato, T.; Watanabe, H. (Japan Atomic Energy Research Inst., Takasaki). Genshiryoku Kogyo; 19: No. 5, 30-34(May 1973). (In Japanese).

Pen. digitatum spores were inoculated into the skin of oranges which were then stored for 1 day and 3, 5, and 7 days, respectively in a control temperature of 5°C. The oranges were irradiated with from 50 to 200 Krad of a 1 MeV electron beam and the effects of radiosterilization were investigated. In the oranges irradiated 1 day and 3 days after inoculation, the growth of the spores was prevented with from 150 to 200 Krad. In the oranges irradiated 5 days after inoculation, 1 out of 8 was decayed with 200 Krad. In the oranges irradiated 7 days after inoculation, 3 were decayed with 250 Krad. Soon after harvesting, oranges were stored in the controlled temperature of 5°C for 2 months and then irradiated with from 150 to 300 Krad of electron beam. Among those, one group was irradiated with from 150 to 300 Krad of electron beam and stored for 17 days at 5°C, while the other was irradiated with from 50 to 300 Krad of ^{60}Co and stored for 60 days. ^{60}Co irradiated oranges were damaged with 50 Krad and lost commercial value, while the electron beam irradiated oranges showed no difference from non-irradiated cases in taste and appearance. It is suggested that the cost of irradiation will be reduced with the use of high-energy electron beams when food irradiation is carried out in great quantity. Application of electron beams to food irradiation and irradiation techniques should be developed further. (JA)

30003 POSSIBLE USE OF GAMMA RADIATION IN WASTE WATER TREATMENT. Ramakrishnan, C. V. (Maharaja Sayajirao Univ., Baroda, India). J. Sci. Ind. Res.; 30: No. 5, 228-234(May 1971).

Safeguarding food supplies and water from microbial and other contamination is an important public health problem as such contamination accounts for the widespread incidence of infections and parasitic infestations. The problem of purifying domestic waste is further complicated by the addition of industrial waste which often has the effect of retarding the natural process of purification. The use of gamma irradiation may help to solve this problem to a considerable extent. Gamma irradiation is found to be effective in the treatment of domestic waste as well

as industrial waste as it does not inhibit the growth of algae which is important for the purification of sewage. Studies made in this connection at the Bhabha Atomic Research Center, Bombay are described. (auth)

30004 PRELIMINARY STUDIES ON THE PRESERVATION OF FALSA (GREWIA ASIATICA). Hussain, A. M.; Ahmad, M.; Farooqi, W. A. (Nuclear Inst. for Agriculture and Biology, Lyallpur, Pakistan). Pak. J. Sci. Ind. Res.; 15: No. 4-5, 320-322(1972).

Some effects of gamma radiation and packing in polyethylene bags were studied on falsa. Fruit packed in polyethylene bags containing $KMnO_4$ developed proper color and remained in good condition for 5 days (at 25°C) while the condition of control fruit deteriorated after 2 days. There was an increase in sugars, while ascorbic acid and acidity decreased during ripening. Alternaria sp. and Helminthosporium sp. seemed to cause fruit decay. (auth)

30005 INDUCTION OF RIPENING DELAY IN MANGOES (VAR. DUSEHRI) BY GAMMA IRRADIATION AND REFRIGERATION. Ahmad, M.; Naqvi, M. H.; Hussain, A.; Mohyuddin, M.; Sattar, A.; Ali, M. (Nuclear Inst. for Agriculture and Biology, Lyallpur, Pakistan). Pak. J. Sci. Ind. Res.; 15: No. 4-5, 314-319(1972).

The effects of gamma irradiation alone and in combination with curing (pal) and refrigeration were studied for causing delay in ripening of dusehri mangoes. Biochemical and physiological paremeters investigated during storage included ethylene production, pectic substances, ascorbic acid, sugars, acidity, total carotenoids, and total soluble solids. A radiation dose of 30 krad was found to be optimum for causing a ripening delay of 7 days in mangoes when stored at room temperature (35 to 38°C). Visual observations revealed that refrigeration did not appear to have any added benefit with irradiation for extending the shelf life of this fruit. Both irradiated and unirradiated mangoes ripened normally under various curing conditions, although the delaying effect of irradiation was maintained. Aspergillus niger and A. flavus were primarily responsible for the spoilage of mangoes. (auth)

30006 EXTENSION OF THE STORAGE LIFE OF PREPARED VEGETABLES BY GAMMA RADIATION. Beczner-Hegyesi, J.; Farkas, J.; Beczassy-Keresztes, K. Acta Aliment.; 1: No. 3-4, 379-399(1972).

Mixed vegetable samples consisting of cleaned and sliced carrots, parsley, kohlrabi, heads of celery, and curly kale were packed in polyethylene bags radiation-treated between 5 and 800 krad and stored at 6, 9 to 12, and 20 to 25°C. During storage the sensory quality and viable cell count were established in comparison to those of untreated samples. It was established that the storage life of prepared mixed vegetables could be extended by 2 days when treated with 200 to 300 krad. An exposure of 200 krad reduced the viable cell count by nearly two orders of magnitude and this difference between the cell count of the radiation-treated and untreated samples remained constant though the cell count increased in both samples during storage. Of the different vegetables tested, celery and parsley were the most prone to spoilage and curly kale the least liable. Instrumental testing of the samples showed a significant softening in carrots treated with 200 krad. However, the initial difference in the consistency of irradiated and untreated carrots became equalized during storage because of the more rapid softening of the untreated carrots. During the first five minutes of cooking in salted water the irradiated samples softened much more rapidly than the untreated, however, during further cooking the softening of the untreated samples accelerated and thus after 15 minutes the consistency of the samples became equal. Because of the appearance of off-odor and off-flavor it is not advisable to apply exposures above 200 to 300 krad. (Hung. Tech. Abstr.)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 29697 and 30056.

30007 (FRNC-R-19, pp 166-167) ACTION OF ANTILYMPHOCYTIC SERUM ON IRRADIATED HUMAN LYMPHOCYTES. Application to the Comparative Study of Radioprotecting Substances. Hainaut, J.; Potherat, J. J.; Fabre, J.; Frossard, H. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

It is suggested that lymphocytes exposed to irradiation are more sensitive to immunological aggression than nonirradiated lymphocytes. The radioprotecting action of cysteamine, serotonine, and C-511 on the phenomena was studied. The results demonstrate that rapid screening tests are useful for testing the action of these radioprotecting substances on the lymphocytes, and for deciding whether a given radioprotecting substance has a direct action on the cells or a more overall action. (FR)

30008 DNA LESIONS AND MAMMALIAN CELL KILLING: CAUSE AND EFFECT. Elkind, M. M.; Ben-Hur, E. (Medical Research Council, London). Israel J. Chem.; 10: No. 6, 1255-1272(1972).

Actinomycin D was found to inhibit repair of sublethal damage, an observation that justified a focus on nuclear DNA as the site of damage and repair. Sedimentation studies with alkaline gradients revealed two repair processes: repair of single-strand breaks (also found by others) and repair to a complex of DNA, lipid, and protein. In cells sensitized to fluorescent light because of prior growth in the presence of 5-bromodeoxyuridine, the data suggest that single-strand breaks are the lethal lesions. In contrast, damage to a DNA-membrane structure appears a more likely target for x-ray cell killing. (auth)

30009 EFFECTS OF γ IRRADIATION ON SOLUTIONS OF CATALASE, APOCATALASE, AND HEMATIN. Lynn, K. R.; Raoult, A. P. D. (National Research Council of Canada, Ottawa). Int. J. Radiat. Biol.; 24: No. 1, 25-31(Jul 1973).

Dilute aqueous solutions of catalase, apocatalase, and hematin were γ-irradiated over a range of doses up to 700 Krads; the hydroxyl radical was the major inactivating species. The initial destruction of the home group in the enzyme was related to the loss of catalytic activity. Cysteyl, histidyl, and tryosyl residues were destroyed during the radiolysis of the apocatalase and catalase and protection of the hematin was afforded by the apoenzyme. (auth)

30010 ENERGETIC ASPECTS OF IRRADIATED MITOCHONDRIA AND RADIOSENSITIZATION WITH THIOLIC REAGENTS. Dinescu, G.; Mihai, C. Oncol. Radiol.; 11: No. 3, 241-248(1972). (In Rumanian).

Determinations were carried out on the effect of radiosensitization with iodoacetamide (IAA) and N-ethylmaleimide (NEM) on certain mitochondrial functions: oxidative phosphorylation pseudo- and energized swelling buffering capacity, using mitochondria irradiated in vitro (1000 R) and in vivo (800 R) in the presence and absence of NEM and IAA. The results obtained suggest that irradiation and sensitization by NEM and IAA induce alteration of the mitochondrial functions by destroying certain membrane mechanisms involved in the transfer of water, electrolytes and protons. (Rom. Sci. Abstr.)

30011 STRUCTURE AND FUNCTION OF IRRADIATED DNA. Hagen, U. (Kernforschungszentrum, Karlsruhe, Ger.). Biophysik; 9: No. 4, 279-289(1973). (In German).

From annual meeting of the Deutsche Gesselschaft fuer Biophysik; Erlangen, Germany (4 Oct 1972).

The effects of ionizing radiation on the physico-chemical structure of DNA and on its biological function are surveyed. The formation of single strand breaks and double strand breaks is described as they arise under various conditions of irradiation, i.e., in dilute aqueous solution, in the dry state, or in the irradiated cell. Much less is known about the damage to the structure of nucleotide bases. The biological function of DNA can be tested in vitro by its template activity in the enzymatic RNA synthesis with RNA polymerase. Whereas the radiation-induced single strand break may preponderantly be responsible for stopping the transcription along the DNA molecule, the base damages may partly lead to insertion of a wrong base into the RNA in the course of transcription. The enzymatic reactions leading to the repair of the radiation damage in the DNA of irradiated cells are considered. The joining of single strand breaks and the substitution of damaged DNA sections by repair replication are described. (auth)

30012 DOES ESCHERICHIA COLI POSSESS A DNA EXCISION REPAIR SYSTEM FOR γ-RAY DAMAGE. Wilkins, R. J. (Oak Ridge National Lab., TN). Nature (London) New Biol.; 244: No. 139, 269-271(29 Aug 1973).

An attempt was made to demonstrate excision repair in γ-irradiated bacteria by studying the disappearance of endonuclease-sensitive sites in Escherichia coli. After anoxic γ irradiation, endonuclease-sensitive sites disappeared in a strain deficient in dimer excision at the same rate as in a proficient strain. When E. coli AB2500 (uvrA-6), a uvr-mutant, was γ-irradiated with 50 krad in N_2, about 2 endonuclease-sensitive sites were produced in the DNA for every direct single strand break. It was found that in all cases these sites had disappeared in 10 min and in 30 min most single strand breaks in the DNA were rejoined. With ultraviolet irradiation no direct single strand breaks were produced, and the endonuclease-sensitive sites produced by a fluence of 100 erg mm^{-2} did not disappear from the uvr^- strain of E. coli AB2500. Although the sites were removed from the uvr^+ strain, the rate was slower than for the sites produced by γ rays, with about 25% still in the DNA after 35 min of post irradiation incubation. It is suggested that these latter sites were associated with pyrimidine dimers and that the two repair systems differ only in the initiation by different endonucleases. (UK)

30013 INVOLVEMENT OF DNA POLYMERASE III IN EXCISION REPAIR AFTER ULTRAVIOLET IRRADIATION. Youngs, D. A.; Smith, K. C. (Stanford Univ., CA). Nature (London) New Biol.; 244: No. 138, 240-241(22 Aug 1973).

A study was made of the ultraviolet survival and repair characteristics of a mutant of Escherichia coli that produces a temperature sensitive DNA polymerase III. At 30°C the polA1 dnaE strain repaired the incision breaks completely within 60 min, after an exposure of 50 erg mm^{-2}, comparable with a polA1 $dnaE^+$ transductant at 42°C. After incubation at 42°C, the polA1 dnaE strain showed little or no repair after an ultraviolet exposure of 25 erg mm^{-2}. More extensive repair was observed after ultraviolet exposures of 5 or 12 erg mm^{-2}. The preincubation at 42°C was necessary for maximal inactivation as, if polA1 dnaE cells were raised to 42°C only after the ultraviolet exposure (25 erg mm^{-2}), a considerable shift in the DNA profile towards higher molecular weight was observed. The results were consistent with the hypothesis that DNA polymerase III is essential for most of the repair of incision breaks occurring in a strain lacking DNA polymerase I. (UK)

30014 ROLE OF DNA POLYMERASE II IN REPAIR REPLICATION IN ESCHERICHIA COLI. Masker, W.; Hanawalt, P.; Shizuya, H. (Stanford Univ., CA). Nature (London) New Biol.; 244: No. 138, 242-243(22 Aug 1973).

Experiments were made showing that the ultraviolet-stimulated non-conservative ATP dependent DNA synthesis observed in toluenized strains of Escherichia coli deficient in DNA polymerases I and III was absent in mutants additionally deficient in DNA polymerase II. Semiconservative DNA synthesis proceeded in both strains at the permissive temperature (32°C) in the presence of ATP. At the restrictive temperature (44°C), unirradiated controls of both strains showed only a low background of nonconservative DNA synthesis. Ultraviolet-irradiated (300 erg mm^{-2}) HS434 cells showed a significant enhancement of repair-like synthesis dependent on ATP. However no nonconservative synthesis was seen in the nearly isogenic DNA polymerase II deficient mutant HS432. It is suggested that DNA polymerase II is responsible for ultraviolet-stimulated DNA synthesis in toluenized E. coli deficient in the other two known DNA polymerases, and that this type of synthesis is not totally attributable to residual DNA polymerase I or III activity. (UK)

30015 DESTRUCTION OF PHOTOREACTIVATING ENZYME BY 365 nm RADIATION. Tyrrell, R. M.; Webb, R. B.; Brown, M. S. (Argonne National Lab., IL). Photochem. Photobiol.; 18: No. 4, 249-254(Oct 1973).

Following the observation that in vivo photoreactivation of 365-nm-induced pyrimidine dimers could not be observed chemically, a study was made of the inactivation of photoreactivating enzyme activity by this near-ultraviolet wavelength. It was observed that: (1) Dimers induced in extracted bacterial DNA by 365 nm radiation were completely photoreactivable and were monomerized as an exponential function of the photoreactivation time. (2) Photoreactivability of 254-nm-induced damage in Escherichia coli B/r Hcr was progressively destroyed in vivo as a function of the dose of 365 nm radiation. (3) The ability of the yeast photoreactivating enzyme to monomerize dimers induced at 365 nm in bacterial DNA was destroyed in vivo as a function

of the dose of 365 nm radiation, and at a rate comparable to killing of E. coli. It is suggested that these results are consistent with biological measurements that indicate that photoreactivability of ultraviolet (near and far) lethal damage is reduced by exposure of the bacteria to 365 nm radiation. (auth)

30016 LESIONS PRODUCED BY ULTRAVIOLET LIGHT IN DNA CONTAINING 5-BROMOURACIL. Hutchinson, F. (Yale Univ., New Haven). Quart. Rev. Biol.; 6: No. 2, 201-246(May 1973).

A review is presented of current knowledge concerning photochemical lesions produced by the action of ultraviolet radiation on 5-bromouracil (BrU) incorporated into DNA in the place of thymine. The subject is discussed under the following headings:- (1) Spectroscopic data, photoproducts in the free base and nucleoside, in BrU dinucleotides and polyribobromouridylic acid, and in BrU-DNA, yields of various photoproducts of BrU and IU, single and double strand breaks. (2) Biological measurements, including the sensitizing effect of BrU incorporation and wavelength dependence of sensitization, the effect on lesions in BrU-DNA of various cellular repair systems, repair of the single-strand break in BrU-DNA, inactivation of bacterial transforming BrU-DNA, and possible mechanisms of sensitization. (UK)

30017 RADIATION CHEMICAL STUDY OF THE INACTIVATION AND ACTIVE SITE COMPOSITION OF CARBOXYPEPTIDASE A. Roberts, P. B. (Inst. of Cancer Research, Sutton, Eng.). Int. J. Radiat. Biol.; 24: No. 2, 143-152(Aug 1973).

Steady-state and pulsed irradiation techniques were applied to the inactivation of carboxypeptidase A. The solvated electron was found to be ineffective as an inactivating species, although it rapidly localized on a disulphide bond. Inactivation of the enzyme with low efficiency was observed for OH and O_2^- radicals, but H atoms are more efficient. Some secondary radicals derived from OH were also found to lead to inactivation. A correlation between the sensitivity of the enzyme to inactivation by the secondary radicals, and the reactivity of these radicals with the enzyme and with free amino acids, led to the identification of tyrosine and tryptophan residues present in the active site of the enzyme. (auth)

Radiation Effects on Cells

Refer also to abstracts 30008, 30045, 30050, and 30083.

30018 FACTORS WHICH INFLUENCE THE SEDIMENTATION PROPERTIES OF MAMMALIAN CELL DNA: EFFECT OF TWO-DOSE X IRRADIATION. Belli, J. A.; Nagle, W. (Harvard Medical School, Boston). Israel J. Chem.; 10: No. 6, 1241-1253(1972).

The sedimentation behavior of DNA extracted from mammalian cells was studied after fractionated irradiation. Our results show that the injury registered by a second x-ray dose is not additive to that registered by the first, and that DNA, having repaired its initial radiation damage, is less susceptible to a subsequent irradiation. The following hypothesis is suggested. Repair processes of DNA begin with unmasking of initiation sites and that, in time, these become associated with membrane material within the nucleus. (auth)

30019 RADIATION-INDUCED STRAND SCISSIONS IN BACTERIAL DNA AND THEIR ENZYMATIC REPAIR. Kaplan, H. S. (Stanford Univ., CA). Israel J. Chem.; 10: No. 6, 1229-1239 (1972).

Abundant evidence indicates that lesions induced in DNA, unless they are repaired, may lead to death of cells exposed to ionizing radiations. Although sugar and base damage undoubtedly occur, the lesions that have been most readily quantifiable by biophysical methods and that, if unrepaired, correlate most closely with lethality are single-strand and especially double-strand chain breaks. Evidence is presented for the existence of several different systems for the repair of single-strand breaks, and some of the relevant enzymes are tentatively identified. Chemical inhibitors of these repair processes were demonstrated. Since these inhibitors act after irradiation and since the consequence of their action is to enhance lethality, they comprise a new class of radiosensitizers. (auth)

30020 HYDRATED ELECTRON, THE HYDROXYL RADICAL, AND HYDROGEN PEROXIDE IN RADIATION DAMAGE IN CELLS. Powers, E. L. (Univ. of Texas, Austin). Contract AT(40-1)-3408. Israel J. Chem.; 10: No. 6, 1199-1211(1972).

Spores of Bacillus megaterium, in suspension, were used to study the biological effects of the three principal products of radiolysis of water, i.e., e_{aq}^-, $^{\cdot}OH$ and H_2O_2. A model is proposed accounting for the action of $^{\cdot}OH$ and H_2O_2. This model involves two reactions, $RH_2 + {}^{\cdot}OH \rightarrow {}^{\cdot}RH + H_2O$ and $^{\cdot}RH + H_2O_2 \rightarrow R + OH^- + H^+ + {}^{\cdot}OH$, in which RH_2 is a "target" molecule, and R is a lethally damaged molecule. Experimental evidence is given supporting this model. These studies of the effects of radiolysis products of water are extended by studies using sensitizers such as biacetyl, NO_3^-, and Ag^+ in varying concentrations. Evidence for a possible relationship between peak sensitivities in anoxic conditions and chemical properties of the sensitizers is discussed. These results are also discussed with regard to the oxygen effect, and the general chemical characteristics of an efficient tumor sensitizer are outlined. (auth)

30021 TRANSFORMATION OF MAMMALIAN CELLS IN VITRO BY LOW DOSES OF X-RAYS. Borek, C.; Hall, E. J. (Columbia Univ., NY). Nature (London); 243: No. 5408, 450-453(22 Jun 1973).

X irradiation of hamster cells in culture, followed by cloning of the cells, was used to obtain a dose-response curve in terms of cell transformation. Transformations were observed for doses as low as 1 rad. (auth)

30022 SPECIFIC INACTIVATION OF SENSITIZED LYMPHOCYTES IN VITRO USING ANTIGENS LABELLED WITH ASTATINE-211. Smit, J. A.; Myburgh, J. A.; Neirinckx, R. D. (Univ. of the Witwatersrand, Johannesburg). Clin. Exp. Immunol.; 14: 107-116 (1973).

This is a study of the use of ^{211}At as an alternative to iodine isotopes in radioactive antigen suicide experiments. The theoretical advantages of ^{211}At are that it is a high energy (5.87 MeV), short half-life (7.2 hr) α-emitter with a short path length of 60 μm. Its destructive effect, measured in terms of degree of ionization per micron, is 300 times that of ^{125}I and ^{131}I. Streptokinase (SK), tuberculin (PPD) and phytohaemagglutinin (PHA) were labeled electrolytically with ^{211}At (3 to 9% incorporation). These antigens were not destroyed by the labeling technique or by self-irradiation during radioactive decay. Autoradiography showed that only a small fraction of lymphocytes bound ^{211}At-labeled SK and PPD while most lymphocytes bound ^{211}At-labeled PHA. Lymphocytes exposed for 40 min to 0.35 to 1.40 μCi of labeled antigens lost 35 to 83% of their ability to transform upon subsequent exposure to the unlabeled antigens. The inhibition was specific in that responsiveness to unrelated antigens was retained. These results extend previous findings with the use of ^{211}At in vivo antigen suicide experiments. (auth)

30023 INFLUENCE OF RADIOTHERAPY ON THE LYMPHOCYTE TRANSFORMATION IN VITRO IN LYMPHOGRANULOMATOSIS, RETICULOSARCOMA AND BRONCHIAL CARCINOMA. Sobbe, A.; Wuttke, H. (Univ., Bonn). Strahlentherapie; 145: No. 6, 680-686(1973). (In German).

The change of the blastemic transformation rate in the culture after addition of tuberculin was tested in patients with lymphogranulomatosis, reticulosarcoma, and bronchial carcinoma. A relation between the possible stimulation of the lymphocytes and radiotherapy and the further course was only found in patients with lymphogranulomatosis. A good radiotherapeutic result caused a significant increase of the primarily diminished lymphocyte transformation, whereas under partial or no regression of the tumor disease such an increase was not seen. Lymphogranulomatosis patients with a constant tendency or no tendency toward lymphocyte stimulation developed a recidivation or progression of the disease within 6 months after the end of irradiation, whereas a deterioration of the disease was observed at the earliest after ten months. In reticulosarcoma and bronchial carcinoma relations of this kind were not seen. In these tumors, however, in some cases a significant increase of the primarily diminished lymphocyte transformation rate was also observed during radiotherapy. (GE)

30024 ANALYSIS OF STUDIES OF THE BIOLOGICAL EFFECT OF HEAVY IONS WITH DIFFERENT LET BASED ON THE THEORETICAL MODEL OF INACTIVATION. I. Theoretical Model of Inactivation. Guenther, K.; Krasavin, E. A.; Kudryashov, E. I.; Ryzhov, N. I.; Schulz, W. Kosm. Biol. Med.; 7: No. 5, 20-23(1973). (In Russian).

It is assumed that cell inactivation is brought about by damages to nuclear DNA that are in their turn induced by ionizations occurring in DNA containing volumes of a known radius. On this basis a theoretical model of cell inactivation by ionizing radiations with different LET was developed. Using the model, the relationship between the number of one-strand and double-strand DNA breakages and radiations with LET differing 10^4 times is analyzed. Theoretical and experimental results show good agreement. (auth)

30025 INFLUENCE OF HYPOTHERMIA ON THE FINE-STRUCTURAL CHANGES OF THE VILLUS CELLS OF THE RAT DUODENUM AFTER LETHAL WHOLE-BODY X-RAY IRRADIATION. Bierther, M.; Schlueter, G. (Institut fuer Allgemeine

und Experimentelle Pathologie der Bundeswehr, Mainz). Strahlentherapie; 145: No. 6, 687-709(1973). (In German).

Forty-eight hrs after transitory hypothermia the villus cells showed signs of increased metabolism indicated by swollen Golgi bodies, numerous intramitochondrial granules, and depositions of glycogen. After irradiation two kinds of damage occurred and these are described. Following irradiation in hypothermia, markedly less damage was found in the villus cells. Relationships between cellular alterations and depressed metabolism during irradiation are discussed. (GE)

30026 BIOPHYSICAL PROPERTIES OF 3.9-GeV NITROGEN IONS. IV. OER and RBE Determinations Using Cultured Mammalian Cells. Hall, E. J.; Lehnert, S. (Columbia Univ., New York). Contract AT(11-1)-3243. Radiat. Res.; 55: No. 3, 431-436(Sep 1973).

Chinese hamster cells cultured in vitro were used as a test system to determine the radiobiological properties of 3.9-GeV nitrogen ions. Samples were irradiated at the Bragg peak of the depth-dose distribution. The oxygen enhancement ratio (OER) was found to be 1.25 for nitrogen ions, compared with 2.2 for x rays. The relative biological effectiveness (RBE) of the heavy ions is a function of dose and, therefore, of the level of biological damage. For a cell-surviving fraction of 10^{-2} the RBE is approximately 2. At lower doses of 50 to 100 rads, corresponding to a cell-surviving fraction of 0.5, the RBE is close to 6. (auth)

30027 FORMATION OF CHROMOSOME ANOMALIES, INDUCED BY ULTRAVIOLET RADIATION AND ETHYLENIMINE, IN MAMMALIAN CELLS AS A FUNCTION OF REGENERATING ACTIVITY. Dubinin, N. P.; Goroshkina, G. I.; MATUSEVICH, L. L.; Zasukhina, G. D. (Inst. of General Genetics, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 2, 464-467(11 May 1973). (In Russian).

People suffering from Xeroderma pigmentosum show an increased sensitivity to ultraviolet and a high frequency of skin cancer. Cells from this system show a decreased ability of the genes to repair damaged nucleotides in the DNA molecule, and an increased level of chromosomal aberrations. Recently (1972) a primary culture of cells from the Syrian hamster was found to simulate the normal cells in man, while a transplanted culture of these cells was similar to the cells of patients suffering from Xeroderma pigmentosum. The character of the chromosome aberrations and their fate were studied under conditions of ultraviolet irradiation and after interaction with ethylenimine. The transplanted cells showed a drop in mitotic activity from 35 to 39% in the controls to 3% on uv irradiation for 5 min. The number of metaphases with aberrations at 30 hr incubation rose from 2% in the controls to 35 to 51% respectively on irradiation for 1, 2, and 5 min. At 12 hr incubation, the number of chromatid deletions was 25 to 48%, end pair deletions 3 to 10%, chromatid dicentrics 4 to 8%, chromosome dicentrics about 1%, while rings were absent. At 30 hr incubation the chromatid deletions were 10 to 17%, end pair deletions 20 to 45%, chromatid dicentrics 2 to 3%, chromosome dicentrics 5 to 7%, and acentric rings 1 to 2%. In the normal cells at 12 hr incubation after irradiation the mitotic activity fell from 19% in the controls to 14.7 and 2% respectively on irradiating for 1, 2, and 5 min. At 30 hr incubation, the mitotic activity increased to 18.1 and 4%. Analysis of chromosome aberrations in these cells showed that at 12 hr incubation after irradiation the number of metaphases with aberrations rose from 2% in the controls to 42 to 55%, while at 30 hr incubation the percent cells with aberrations was 20 to 30% respectively on irradiating 1, 2, and 5 min. The decrease in chromosome aberrations under postradiation conditions is most likely connected with the recuperative part of the potential changes. The transplanted cells do not recover readily, but rather continue to show a low level of mitotic activity. The cells were treated with 10^{-4} molar ethylenimine for one hour, and the cells were fixed 12, 24, and 72 hrs after treatment. Analysis showed that at 24 hr incubation the number of chromosome aberrations increased from 1 to 2% in the controls to 30 to 35% after treatment with the mutagenic agent. At 72 hr incubation the percent of rearrangements remains at a high level in both cultures. The mitotic activity decreased for both cultures. Chromatid deletions were 25 to 30%. (SJR)

30028 REPAIR REPLICATION IN HETEROKARYONS DERIVED FROM DIFFERENT REPAIR-DEFICIENT XERODERMA PIGMENTOSUM STRAINS. de Weerd-Kastelein, E. A. (Erasmus Univ., Rotterdam); Kleijer, W. J.; Sluyter, M. L.; Keijzer, W. Mutat. Res.; 19: No. 2, 237-243(Aug 1973).

Repair replication was studied in uv-irradiated cell populations obtained after fusion of cell strains originating from different xeroderma pigmentosum (XP) patients. The capacity to perform repair replication appeared to be restored completely in multinucleate heterokaryons resulting from fusion between a classic XP-strain and a De Sanctis-Cacchione (DSC) strain. In cell populations obtained by fusion of either two different classic XP strains or two different DSC strains no repair replication was observed. These results, obtained with the technique of density labelling and isopycnic centrifugation of DNA, confirm our previously reported results of autoradiographic studies of unscheduled DNA synthesis. The occurrence of complementation between a classic XP strain and a DSC strain indicates that the defect in the two forms of the disease is caused by different mutations. (auth)

30029 USE OF A UV ENDONUCLEASE FROM MICROCOCCUS LUTEUS TO MONITOR THE PROGRESS OF DNA REPAIR IN UV-IRRADIATED HUMAN CELLS. Paterson, M. C.; Lohman, P. H. M.; Sluyter, M. L. (Leiden Univ., Netherlands). Mutat. Res.; 19: No. 2, 245-256(Aug 1973).

A sensitive enzymatic assay has been developed to follow the progress of DNA repair in human cells exposed to uv radiation. The assay employs an endonuclease selectively active at sites containing pyrimidine dimers in uv-damaged DNA. Primary fibroblasts are exposed to 254 nm radiation and incubated for specified times, their radioactively labelled DNA is isolated and treated with a uv endonuclease extensively purified from Micrococcus luteus. Endonuclease-susceptible sites remaining in the DNA are subsequently observed as single-strand scissions by sedimentation in alkaline sucrose gradients. In comparison to the situation with excision-proficient normal cells, those derived from patients suffering from either the classical or the De Sanctis-Cacchione clinical form of Xeroderma pigmentosum (XP) exhibit a marked diminution in the rate of disappearance of nuclease-susceptible lesions with time of post-uv incubation. (auth)

30030 RADIATION DAMAGE AND RECOVERY OF CELL SURFACE CHARGE AND COLONY FORMING ABILITY IN THREE CELL SPECIES. Sato, C.; Kojima, K.; Onozawa, M. (Aichi Cancer Center, Nagoya, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 211-216(1972). (In Japanese).

Alterations in the negative surface charge after x irradiation was investigated by cell electrophoresis on three cell species; Burkitt lymphoma cells P3HR-1 ($n = 1$, $D_0 = 67$ R), mouse mammary carcinoma cells FM3A (2.5, 150 R), and mouse melanoma cells B16-C2W (20, 160 R). The electrophoretic mobility decreased with time after irradiation and reached a minimum 4 hrs after exposure. The relationship between the decrease in the mobility during 4 hrs and the radiation dose was the same on three cell species and consisted of two straight lines. In Burkitt lymphoma cells the decrease in the mobility was irreversible. Whereas, the negative surface charge recovered after the irradiation with 50 R in FM3A, and after doses below 500 R in C2W. The surviving fractions on colony forming ability and the fractions of electrophoretically recovered cells during 24 hrs after exposure showed good correlation on five doses in C2W. (auth)

30031 MECHANISMS OF ACTION OF THE INHIBITORS OF CELL POSTRADIATION RECOVERY. I. The Caffeine Inhibition of the Rejoining of Radiation Induced Single-Strand Breaks in Human Lymphocyte DNA. Haikazyan, E. V.; Mikhelson, V. M.; Zhestyanikov, V. D. (Inst. of Cytology, Leningrad). Tsitologiya; 15: No. 7, 881-887(Jul 1973). (In Russian).

Tritiated thymidine labeled cultured human peripheral lymphocytes were gamma-irradiated in doses of 10 to 30 krad. Both irradiated and non-irradiated cells were lysed and centrifuged in the sucrose alkaline gradient to get the patterns of DNA distribution according to the molecular weights. The irradiation was shown to reduce considerably the molecular weight of DNA resulting in single-strand breaks in it (20 krad gamma-irradiation decrease the molecular weight of DNA from $50 \cdot 10^6$ to $4.5 \cdot 10^6$ daltons). A 60 min incubation of irradiated cultures at 37°C resulted in an almost complete rejoining of these breaks. Caffeine available in the incubation media ($6 \cdot 10^{-4}$ and $6 \cdot 10^{-3}$ M) prevented their rejoining. This postradiation effect increased with the dose applied. (auth)

30032 MARKED CHROMOSOME ASSOCIATIONS IN MONKEYS. I. The Association Frequency of Nucleolus-Organizing Chromosomes in Cultured Lymphocytes at Different X-ray Doses and the Quantitative Analysis of Nucleoli. Dzhemilev, Z. A. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Tsitologiya; 15: No. 8, 1043-1048(Aug 1973). (In Russian).

The frequency of cells with nucleolus organizing chromosome associations and the number of nucleoli were studied in the cultured peripheral blood leukocytes of Macaca mullatta aged from 9 to 12 yrs. The cultures were irradiated with 25, 50, 100, 200, and 400 R, resp., at G_0-stage. Among small lymphocytes, two types of blastoid cells were distinguished, with one and with two nucleoli. The small lymphocytes producing marked association has one nucleolus, whereas those without marked chromosome associations displayed two nucleoli, the two kinds of cells are thought to represent two correspondfng stages of small lymphocyte maturation. (auth)

30033 CAFFEINE-SENSITIVE REPAIR OF uv-DAMAGED DNA IN MAMMALIAN CELLS. Fujiwara, Y.; Kondo, T. (Kobe Univ., Japan). Saibo Seibutsugaku Shinpojiumu; 23: 41-47(1972). (In Japanese).

Caffeine added immediately after uv irradiation reduced the survival in terms of n and Do of mouse L5 cells more drastically than HeLa S3 cells. Delayed addition of 1 mM caffeine after irradiation to synchronized L5 cells revealed that the process of caffeine-sensitive recovery required the first postirradiation DNA synthesis. L5 cells cannot excise thymine dimer (TT) that was yielded at an approximate rate of 0.05% T/100 ergs/mm^2, but HeLa S3 cells excise about 50% TT within 24 hr. Correspondingly, the extent of unscheduled synthesis is found very little in L5 cells in contrast to the extensive ability of HeLa S3 cells to repair-replicate. The ^{14}C-TdR-prelabeled, thymidilate-deficient L5 cells were exposed to uv and rescued with ^{3}H-TdR. Alkaline sucrose sedimentation of the DNA reveals that a 2-hr replication on the ^{14}C-template containing dimers produces discontinuous ^{3}H-daughter strands with gaps that are probably complementary to dimers. With a further incubation for 24 hr, the slow sedimenting ^{3}H-DNA was converted to the material in size of the ^{14}C-template. Two mM caffeine inhibited the conversion completely. In contrast, excision-repair-capable HeLa S3 cells did not reveal such an inhibition after an incubation for 24 hr in the presence of 2 mM caffeine. In conclusion: excision-deficient L5 cells tolerate uv damage by bypassing through the mechanism similar to recombinational repair (Rupp and Howard-Flanders); caffeine may interfere specifically with this particular repair in L5 cells; and caffeine does not appear to exert its effect on excision repair of HeLa S3 cells. (auth)

30034 DNA SINGLE-STRAND REJOINING IN TWO PAIRS OF CELL LINES SHOWING THE SAME AND DIFFERENT SENSITIVITIES TO X-RAYS. Fox, B. W.; Fox, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 24: No. 2, 127-135(Aug 1973).

The numbers of single-strand breaks and their rates of rejoining were compared in two Yoshida sarcoma cell-lines showing similar sensitivity to x rays (D_0 85 rads, n = 2.5) and two L5178Y cell-lines showing differential sensitivity; the sensitive cell-line having a D_0 value of 55 rads, n = 2.5, and the resistant line a D_0 value of 160 rads and n = 3.0. After doses of 5 or 10 krads, no differences in the numbers of single-strand breaks produced or in their rates of rejoining were observed when measured by the alkaline sucrose gradient technique. The findings confirm that single-strand breaks in themselves are not lethal events, since similar numbers are produced and virtually all are rejoined in the cell-lines studied. However, a deficiency in some of the processes involved in repair replication could be the cause of their differential sensitivity by allowing damage to be fixed. (auth)

30035 REPAIR OF DNA DAMAGE IN ULTRAVIOLET-SENSITIVE CELLS ISOLATED FROM HeLa S3 CELL LINE. Horikawa, M.; Fukuhara, M.; Isomura, K.; Suzuki, F. (Kanazawa Univ., Japan). Saibo Seibutsugaku Shinpojiumu; 23: 11-17(1972). (In Japanese).

Two uv sensitive cell lines designated S-1M and S-2M were isolated from the original HeLa S3 cell line by using the mutagen N-methyl-N′-nitroso-soguanidine (MNNG)-ultraviolet light (UV light) and 5-bromodeoxyuridine (BUdR)-visible light method. The Do values were 87, 68, and 45 ergs/mm^2, and the extrapolation numbers(n) were 1.4, 1.0, and 1.0 in the case of HeLa S3, S-1M, and S-2M cells, respectively. The average initial excision rate of uv-induced thymine dimers in the uv-sensitive cells is approximately one fifth that in HeLa S3 cells. Furthermore, using the alkaline sucrose gradient method, it was shown that uv-specific endonuclease, i.e., the enzyme presumed to initiate repair processes, may be lacking or is non-functional in uv-sensitive S-2M cells, as in the case of cells from Xeroderma pigmentosum. The uv-sensitive cells may appear in the original HeLa S3 population due to the mutagenic action of MNNG. S-2M cells are more sensitive to the carcinogen 4-nitroquinoline 1-oxide (4-NQO) than HeLa S3 cells. However, there are no significant differences in the sensitivity to x irradiation of the three cell lines. The findings indicate that the 4-NQO-induced DNA damage and its repair are similar to those found after uv irradiation, but different from those after x irradiation. (auth)

30036 ISOLATION OF MAMMALIAN CELL DNA AND ITS RADIOINDUCED DAMAGE AND REPAIR. Terasima, T. (National Inst. of Radiological Sciences, Chiba, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 25-33(1972). (In Japanese).

The sedimentation profile of double stranded DNA released by lysing mouse L cells with 2% SDS (sodium dodecyl sulfate) solution has been useful in studying the damage and repair after irradiation. However, some physico-chemical as well as morphological properties of the SDS-DNA revealed that the higher order structure of chromosome was conserved together with a slight protein contaminant. Another method that lyses cells in a hot 0.8M-NaCl solution was developed to dissociate nuclear protein of HeLa S3 chromosome. The sedimentation of NaCl-DNA resulted in a very consistent sedimentation profile. The median value of the molecular weight was 1.7×10^8 daltons for HeLa S3-DNA, and 1.4×10^8 daltons for mouse L5-DNA. The mean length and the range of molecules were comparable to those of the replicating unit obtained from the DNA-autoradiography reported by others. The efficiency of double break induction by x ray was 1.5 breaks/cell/rad or 660 eV/break. The incubation of irradiated cells permitted the repair of broken pieces at the rate of 50 min for the half-life of breaks remaining. A possible model for the repair was considered. The mild treatment of cells with a hot NaCl disclosed another fraction that was presumably composed of DNA and less dense materials, e.g., a nuclear membrane. Several properties of this fraction were briefly mentioned, and a possible importance of studying the structure was suggested in relation to the DNA replication and lethality. Particular emphasis was laid on the point that studies regarding the damage and the repair in mammalian DNA should be accompanied by an elucidation of chromosome structure. (auth)

30037 RADIOCYTOLOGICAL PROPERTIES OF RADIATION DAMAGE AND ITS REPAIR STUDIED WITH HeLA CELLS BY THE TECHNIQUE OF ULTRAVIOLET-MICROBEAM IRRADIATION. Takeda, S. (Mie Prefectural Univ., Tsu, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 1-9(1972). (In Japanese).

Lethal effects of independent irradiation of nucleus or cytoplasm were observed by phase-contrast microscopy for 24 hrs after irradiation. The irradiation of cytoplasm induced cell degeneration and cell death at high doses more rapidly and frequently than the irradiation of nucleus. In the former, the cell death occurred with sudden shrinkage of cytoplasm several hours after a stationary state with or without slight morphological degeneration. In the latter, the cell developed vacuolar degeneration of cytoplasm gradually and died finally. Irradiation of the nucleus at G_1 phase with low doses, 37 to 75 ergs, accelerated the initiation of S phase. This effect was clearly detected in the cells of delayed G_1 phase. Rates of unscheduled DNA synthesis during different phases of the cell cycle were calculated from autoradiographic results obtained by the technique of half-nucleus irradiation in combination with hydroxyurea treatment. Data suggested that S-phase was more sensitive to ultraviolet irradiation and subsequently to induction of unscheduled DNA synthesis than the other phases. (auth)

30038 REQUIREMENT OF ATP FOR THE REJOINING OF X-RAY-INDUCED DNA BREAKS IN EHRLICH ASCITES TUMOR CELLS. Matsudaira, H.; Furuno, I. (National Inst. of Radiological Sciences, Chiba, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 35-40(1972). (In Japanese).

In order to get more information on the role of ATP in DNA rejoining, we developed a system in which the rejoining can be studied in vitro. Nuclei were isolated from Ehrlich ascites tumor cells that had previously been labeled with ^{3}H-thymidine and irradiated with x rays, and incubated under different conditions. After incubation, they were treated by the alkaline sucrose gradient method, and the number of breaks in their DNA was determined by sedimentation analysis. It was found that a portion of x-ray-induced breaks in DNA rejoined after incubation of irradiated nuclei in the cytoplasmic supernatant supplemented with ATP, NAD, and 3-phosphoglycerate. Further addition of 4dNTP, although essential for maximal incorporation of ^{3}H-TTP into the DNA of isolated nuclei, did not influence to increase in the rejoining, indicating that the major DNA synthesis is not required for the rejoining. Bovine plasma albumin supplemented with pyruvate kinase and phosphoenolpyruvate could not replace the cytoplasmic supernatant, even in the presence of the cofactors mentioned above. It is concluded that ATP and NAD are directly involved in the rejoining of a portion of x-ray-induced DNA strand breaks, possibly as cofactors of repair enzyme(s) present in the cytoplasm of the cells. (auth)

30039 POTENTIATION OF ULTRA-VIOLET LIGHT DAMAGE IN MOUSE L CELLS BY 1-CYCLOHEXYL-3-(2-MORPHOLINYL-4-ETHYL) CARBODIIMIDE METHO-P-TOLUENE SULPHONATE (CMEC). Rauth, A. M.; Domon, M. (Univ. of Toronto). Int. J. Radiat. Biol.; 24: No. 2, 189-198(Aug 1973).

The agent 1-cyclohexyl-3-(2-morpholinyl-4-ethyl) carbodiimide metho-p-toluene sulphonate (CMEC) was shown to bind preferentially to uv-induced single-stranded regions in DNA. Mouse L cells were assayed for their colony-forming ability after uv irradiation in the absence and presence of various concentrations of CMEC. Ultraviolet-irradiated cells were more sensitive than unirradiated cells to continual exposure to CMEC. The concentration of CMEC that reduced the survival of control cells by 50%

D_{50}, was approximately 0.8 mg/ml, whereas the D_{50} for uv-irradiated cells was approximately 0.15 mg/ml. The same differential toxity was observed by exposing cells to CMEC at a higher concentration for a shorter time immediately after uv irradiation. If uv-irradiated cells were incubated in the absence of CMEC for approximately one generation time immediately after irradiation, the subsequent addition of the drug had no potentiating effect. In contrast CMEC did not potentiate x-ray damage to these cells. It is suggested that CMEC could react preferentially with uv-induced partially-denatured regions in DNA and inhibits their repair and/or normal DNA replication, so that cell lethality is increased. (auth)

30040 DIAMIDE: A NEW RADIOSENSITIZER FOR ANOXIC CELLS. Harris, J. W.; Power, J. A. (Univ. of California, San Francisco). Radiat. Res.; 56: No. 1, 97-109(Oct 1973).

The effect of the glutathione-oxidizing reagent, diamide, on the radiosensitivity of euoxic and anoxic bacteria (Pseudomonas fluorescens) and Chinese hamster cells (V79, B14FAF, and CHO) was studied. Doses of diamide just sufficient to oxidize cellular nonprotein sulfhydryl completely do not sensitize euoxic or anoxic mammalian cells to x rays. Excess reagent, however, sensitizes cells irradiated in nitrogen but not in air. A similar situation was found in P. fluorescens: anoxic cells are sensitized by diamide, whereas the survival of euoxic cells is unaffected by it. Sensitization of anoxic mammalian cells by diamide is unique in that the reagent causes only a small decrease in D_0 (approximately 30%) but completely removes the shoulder of the survival curve—i.e., the extrapolation number is reduced to one. Preliminary results indicate that a combination of diamide and the slope-modifying compound, nifuroxime, sensitizes anoxic V79 cells better than either compound alone and, in fact, better than oxygen. The results are discussed in relation to the role of endogenous nonprotein sulfhydryl in radiation sensitivity and to the possible use of diamide as a radiosensitizer for anoxic tumor cells in vivo. (auth)

30041 INDUCTION OF AGGREGATION OF HUMAN BLOOD PLATELETS BY ULTRAVIOLET LIGHT: ACTION SPECTRUM AND STRUCTURAL CHANGES. Doery, J. C. G.; Dickson, R. C.; Hirsh, J. (McMaster Univ., Hamilton, Ont.). Blood; 42: No. 4, 551-555(Oct 1973).

Exposure of washed human platelets to ultraviolet light is followed by platelet aggregation. The effect occurs at wavelengths between 302 and 225 mμ with a maximal response at 248 mμ, and the effect is greatly enhanced by the addition of fibrinogen. Platelets exposed to ultraviolet light show ultrastructural changes which can be induced independently of aggregation if the addition of fibrinogen is omitted. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 30004, 30005, 30012–30015, 30019, 30020, and 30078.

30042 (AD-761837) EFFECT OF AUTOGAMY ON CELLULAR SENSITIVITY TO NATURAL IONIZING RADIATIONS AND X RAYS. Final Scientific Report, 1 June–31 October 1972. Planel, H.; Soleilhavoup, J. P.; Tixador, R.; Croute, F.; Richoilley, G. (Toulouse Univ. (France)). 13 Apr 1973. 12p. (EOAR-TR-73-12). NTIS.

It is shown that, after autogamy, there is a large decrease of radiosensitivity of Paramecium aurelia to natural ionizing radiations or to x rays. These modifications come in addition to the well known physiological changes induced by conjugation or autogamy in Paramecium. The origin of these modifications cannot be determined. Nevertheless, nuclear reorganization involved by autogamy may explain the modifications of chromosome number and may result in large fluctuation of radiosensitivity in many species. New investigations are in progress to try to determine the mechanism involved in cellular response to natural ionizing radiation. (auth)

30043 (CONF-710501-P2, pp 1229-1236) STRUCTURE AND FUNCTION OF HARDWOOD LITTER AND SOIL SUBSYSTEMS AFTER CHRONIC GAMMA IRRADIATION. II. Microfungi. Cowley, G. T. (Univ. of South Carolina, Columbia); Martin, J. W.; Coleman, D. C. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The microfungal populations in six experimental and two control plots were studied before and after irradiation for 113 days with a 9200-Ci ^{137}Cs source. Experimental plots received cumulative dosages ranging from 5 million to 4 thousand rads. The number of detectable propagules was reduced sharply in the three plots receiving the highest dosages. Recovery was slow, since reduced populations in the soil were still in evidence 13 months after termination of irradiation. Species composition of soil and litter populations was also seriously altered. Before irradiation, populations in all plots were predictably similar. However, immediately after irradiation, an abnormally high percentage of both soil and litter species isolated from the most heavily irradiated sites was darkly pigmented, and populations displayed little similarity to those in control and lightly irradiated sites. Some lightly pigmented or nonpigmented species soon became reestablished. However, similarities between heavily irradiated plots and nonirradiated plots remained low and had not returned to preirradiation levels in the soil by 13 months after irradiation. Apparent recovery of litter populations was more rapid than for soil populations in regard to both number of detectable propagules and species composition. (auth)

30044 (CONF-730655-1) TEMPERATURE DEPENDENCE OF THE ULTRAVIOLET RADIATION SENSITIVITY OF CLEAN, DRY T_1 BACTERIOPHAGE: RELATION TO A HOST-REPAIRABLE COMPONENT OF IONIZING RADIATION DIRECT ACTION. Fluke, D. J. (Duke Univ., Durham, N. C. (USA). Dept. of Zoology). [nd]. 9p. Dep. NTIS $3.00.

From 1st annual meeting of the American Society for Photobiology; Sarasota, Florida, USA (10 Jun 1973).

T1 bacteriophage was exposed to ultraviolet radiation under conditions of ambient temperature (78°K) and the temperature of liquid nitrogen (298°K). The plaque survival curves showed some repairable damage. Results are presented for phage grown on two host strains, Escherichia coli B and E. coli s1. Survival curves following irradiation with fast electrons were also obtained. Studies on photoreactivation of phage irradiated in the dry state were carried out and results are tabulated. (HLW)

30045 MECHANISM OF PHAGE INACTIVATION BY RADIATION. Dewey, D. L. (Mount Vernon Hospital, Northwood, Eng.). Israel J. Chem.; 10: No. 6, 1213-1228(1972).

Bacteriophage show two completely different types of response to radiation depending on whether they are irradiated in dilute aqueous solution, where the major lethal event is due to external radicals formed in the water, or whether they are irradiated in nutrient broth or some other radical scavenging medium; under these protected conditions a major lethal event is double strand breaks in the DNA. Single strand breaks do not appear to matter but the contribution of base damage has not yet been directly measured. In dilute solution the most effective radical for phage inactivation is the hydrogen atom followed by the OH radical and the hydrated electron, in that order. The mechanism of inactivation appears to be a radical attack on the phage tail causing a premature release of the DNA from the phage head. It is suggested that the energy for DNA release is stored in the tail and that the hydrogen atom triggers the release of this energy. (auth)

30046 RADIOSENSITIZING ACTIONS OF KETONIC AGENTS AND OXYGEN IN BACTERIAL SPORES SUSPENDED IN AQUEOUS AND NON-AQUEOUS MILIEUX. Tallentire, A.; Jones, A. B.; Jacobs, G. P. (Univ. of Manchester, Eng.). Israel J. Chem.; 10: No. 6, 1185-1197(1972).

Increasing concentrations of the ketonic agents, diacetyl, acetone, acetophenone, and p-nitroacetophenone, caused regular increases in the radiosensitivity of aqueous anoxic spores to an extent that is some 40% of that achieved by O_2 alone; no effect on radiosensitivity was observed with agents in the presence of O_2. The effectiveness of these agents and O_2 as radiosensitizers ranks on a molar basis in the same order as that of their electron affinities, indicating that their modes of action are in some way associated with radioinduced electrons. A lack of radiosensitizing action of diacetyl and p-nitroacetophenone in dried spores and of p-nitroacetophenone in suspensions of spores in nonaqueous liquids supports the notion that the origin of their actions is within the water inside the cell. (auth)

30047 ISOLATION AND CHARACTERIZATION OF A MUTANT OF SALMONELLA TYPHIMURIUM DEFICIENT IN A MAJOR DEOXYRIBONUCLEIC ACID POLYMERASE ACTIVITY. Whitfield, H. J.; Levine, G. (Univ. of Michigan, Ann Arbor). J. Bacteriol.; 116: No. 1, 54-58(Oct 1973).

A mutant of Salmonella typhimurium strain LT2 that is deficient in a major deoxyribonucleic acid (DNA) polymerase activity was isolated and characterized. This mutant resembles the pol mutants of E. coli in that it has low DNA polymerase activity and it is sensitive to methyl methanesulfonate as well as ultraviolet irradiation. Revertants selected for methyl methanesulfonate resistance are no longer sensitive to ultraviolet irradiation and contain normal DNA polymerase levels. No direct role in replication can be ascribed to this polymerase activity since cells grow well in its absence. In addition, the LT2 plasmid had been shown to exist in the mutant strain. (auth)

30048 EVIDENCE FOR THE CONTROL BY exrA AND polA GENES OF TWO BRANCHES OF THE uvr GENE-DEPENDENT EXCISION REPAIR PATHWAY IN ESCHERICHIA COLI K-12. Youngs, D. A.; Smith, K. C. (Stanford Univ., CA). J. Bacteriol.; 116: No. 1, 175-182(Oct 1973).

A polA1 exrA strain of Escherichia coli K-12 was found to be more sensitive to ultraviolet radiation than the closely related polA1 or exrA strains, but not as sensitive as either the exrA uvrB or recA strains. The exrA and polA1 mutations both resulted in a deficiency in the repair of single-strand breaks arising in the deoxyribonucleic acid as a result of the excision repair process (incision breaks). These deficiencies were at least partially independent since the double mutant, polA1 exrA, was more deficient than a strain containing either the polA1 or exrA mutation alone. These results suggest that the polA1 and exrA mutations result in defects in two different branches of the uvr gene-dependent excision repair process. The repair of incision breaks was still observed in the polA1 exrA strain after low exposures of ultraviolet radiation, suggesting the existence of a third branch of the excision repair process which is dependent on neither the polA nor exrA genes. The polA1 and polA1 uvrA strains were not deficient in post-replicational repair. The exrA strain was partially deficient in post-replicational repair, but the polA1 exrA strain was no more deficient than the exrA strain in this repair process. Thus, the increased ultraviolet irradiation sensitivity of the polA1 exrA strain relative to the polA1 and exrA strains appears to be related to the effect of the polA1 and exrA mutations on different branches of the uvr gene-dependent excision repair process as well as to the effect of the exrA mutation on the post-replicational repair process. (auth)

30049 DEGRADATION OF CELLULAR DEOXYRIBONUCLEIC ACID AFTER GAMMA IRRADIATION OF SPHEROPLASTED ESCHERICHIA COLI CR thy$^-$ CELLS. Christensen, R. C.; Keller, K.; Pollard, E. C. (Pennsylvania State Univ., University Park). J. Bacteriol.; 116: No. 1, 491-493(Oct 1973).

Gamma-irradiated Escherichia coli CR thy$^-$ cells and spheroplasts, prelabeled with ^{14}C-thymine, were assayed for acid-insoluble activity as a function of incubation time after irradiation. Under similar irradiation and incubation conditions, degradation profiles of cells and spheroplasts were virtually identical. Similar results were found for cells and protoplasts irradiated in the presence of rifampin (20 μg/ml). These results suggest that postirradiation deoxyribonucleic acid degradation enzymes are probably not loosely localized in the periplasm, unlike endonuclease I. (auth)

30050 RESTORATIVE EFFECTS OF POST-IRRADIATION CHEMICAL TREATMENTS. Sugahara, T. (Kyoto Univ.). Radioisotopes (Tokyo); 22: No. 2, 95-103(Feb 1973). (In Japanese).

Studies of nucleic acid precursors that accelerate the course of recovery from radiation injuries were carried out for over 3 years since 1969 by the Japan Isotope Association on the Grant for the Peaceful Uses of Atomic Energy. The reproducibility of the results was investigated in experiments conducted in separate laboratories under the same conditions, in which the same substance was used on the various kinds of living organism at various levels (Escherichia coli, mammal cells such as cultivated cells and ascites-tumor cells, and killifish and mice). The variation of the survival rate of chromosome abnormality or the DNA amount or body weight was used as an indicator of recovery according to the kind of experimental materials. The administration of Nucleton or adenosine, a mixture of those in particular, after lethal irradiation was confirmed effective in reducing acute mortality. However, recovery mechanism of the cells in the hematopoietic organs could not be clarified. No recovery effect in relation to the survival rate was recognized at cell level. The study confirmed that a mixture of deoxyribonucleosides acted effective for cell recovery of cultivated mammals considering the increase of the survival rate of those cells. The recovery mechanism, however, was not ascertained while increase of the survival rate for 30 days was observed in the experiment. (JA)

30051 EFFECTS OF PLOIDY UPON CELL CYCLE DEPENDENT CHANGES IN X-RAY SENSITIVITY OF SACCHAROMYCES CEREVISIAE. Nunes de Langguth, E.; Beam, C. A. (Brooklyn Coll., NY). Contract AT(30-1)-3998. Radiat. Res.; 55: No. 3, 501-506(Sep 1973).

Comparison of the x-ray responses of cells of isogenic haploid, diploid, and hexaploid strains of Saccharomyces cerevisiae showed that the early budding cells of diploids are significantly more resistant than those of haploids, which are in turn more resistant than those of hexaploids. Studies of synchronous cultures showed that, although with all strains the fraction surviving a single dose oscillates between extreme values during the cell cycle, the haploids showed the longest radioresistant phase and the hexaploids the shortest, and that increase in ploidy diminishes the relative increase in resistance achieved during prebudding and early budding. In view of evidence that budding cell resistance results from repair and the evidence favoring an increasing role with increased ploidy of dominant (relative to recessive) lethal damage in the x-ray inactivation of yeast, it is proposed that budding cell repair is more effective on recessive than on dominant lethal damage. (auth)

30052 IONIZING RADIATION STUDIED WITH BACILLUS SUBTILLIS 168 THY- TRY- VEGETATIVE CELLS AND SPORES. Cyr, W. H. University Park; Pennsylvania State Univ. (1972). 92p. University Microfilms Order No. 73-21,262.

Thesis (Ph. D.).

The effects of ^{60}Co γ-irradiation on the colony forming ability (CFA), and on both the synthetic and degradative processes in germinating Bacillus subtilis 168 thy- try- spores were studied. These spores are about five times more resistant with respect to CFA than the vegetative cells. The sensitivity to ionizing radiation increases during the germination event. Synthesis of RNA and protein in the control cultures starts within the first few minutes of germination, DNA synthesis at about 40 minutes. Irradiation does not alter the beginning of these synthetic events, but does affect rates. The data on B. subtilis show a pattern of increased sensitivity as the spore germinates. Irradiating B. subtilis spores provided an opportunity to examine the effects on DNA synthesis in a situation where little or no post-irradiation DNA degradation occurs. Three different patterns of post-irradiation DNA degradation were found in germinating spores. First, when B. subtilis is irradiated as a spore, there is little or no degradation. Second, when B. subtilis is allowed to germinate for a period of time less than 40-50 minutes prior to irradiation, there is degradation, but with a lag. Third, when B. subtilis is allowed to germinate for a period of time greater than 40-50 minutes prior to irradiation, there is immediate breakdown of DNA similar to the type found in vegetative cells. The modified pattern of DNA degradation seen in germinating spores is another argument for the hypothesis that the DNA in a bacterial spore is in a different physical state from that found in a vegetative cell. (Diss. Abstr.)

30053 NUCLEAR AND MITOCHONDRIAL DNA SYNTHESIS IN GAMMA RAY-RESISTANT AND -SENSITIVE SLIME MOLD AMEBAS. Deering, R. A.; Jensen, D. S. (Pennsylvania State Univ., University Park). Biophys. J.; 13: No. 8, 780-794(Aug 1973).

Uptake of [methyl-^{3}H]thymidine label from Escherichia coli 15T$^-$ into the DNA of Dictyostelium discoideum was measured in control and [^{60}Co] gamma-irradiated cells of the resistant strain NC-4 (D_{10}, colony-forming survival = 300 krad) and two sensitive daughter strains, γs-18 (D_{10} = 75 krad) and γs-13 (D_{10} = 4 krad). Nuclear (n) and mitochondrial (m) DNA were resolved by isopycnic CsCl gradients. The uptake of label into n-DNA during the immediate postirradiation period was selectively inhibited by irradiation, compared with uptake into m-DNA. For all three strains, the gamma dose to reduce the uptake into n-DNA to 37% of the control during the first hour after irradiation was 3 krad, whereas for uptake into m-DNA it was 75 krad. After the initial dose- and strain-dependent lag, uptake into n-DNA resumed. γs-18 showed longer lags in n-DNA synthesis and cell division than did NC-4. γs-13 resumed n-DNA synthesis and cell division after slightly shorter lags than for NC-4. The early postlag uptake into n-DNA in this strain was almost at the control rate and was accompanied by division until the cell number had nearly doubled. The rate of label uptake then declined, division stopped, and gradual cell lysis ensued. The postdelay response of γs-13 was almost independent of dose in the range of 10 to 100 krad. The response of γs-18 in these and earlier experiments is consistent with the viewpoint that it is sensitive because of a decreased rate of repair of DNA damage. However, the basis for the sensitivity of γs-13 seems to be more complex. This strain undergoes a premature but short-lived burst of n-DNA synthesis and division for what appears to be about one round of replication. Replication then ceases, even at very low doses, leading to greatly reduced probability of survival. (auth)

30054 GENETIC ANALYSIS OF UV INACTIVATION, RECOVERY, AND REGULATORY PHENOMENA IN A STRAIN OF THE YEAST SACCHAROMYCES CEREVISIAE. Parry, E. M.; Parry, J. M. (Univ. Coll. of Swansea, Wales). Mol. Gen. Genet.; 124: No. 2, 117-133(1973).

The responses of a strain of yeast 2nL to uv radiation and various post-uv treatments are described. Six complete tetrads of spores from 2nL were isolated and the ascospore cultures were examined in the same way. Two major genes controlling the repair systems were segregated. One of these may be involved in a switch gene repair operated control of recombination. (auth)

30055 ANALYSIS OF CLONAL SURVIVAL CURVES OBTAINED ON γ-IRRADIATED CHLORELLA CELLS AT SEVERAL

DOSE RATES. Gilet, R.; Santier, S. (CEN, Grenoble, France). Biophysik; 9: No. 4, 335-348(1973). (In French).

The survival curves of Chlorella cells in G_0 stage were studied after split or single gamma irradiation at high or low dose rates. It is possible to explain the curves obtained by the effects of three types of damage: directly lethal damage, repairable sublethal damage, and non-repairable sublethal damage. (GE)

30056 DNA DAMAGE AND BIOLOGICAL FUNCTION OF HUMAN ADENOVIRUS AFTER UV-IRRADIATION. Rainbow, A. J.; Mak, S. (McMaster Univ., Hamilton, Ont.). Int. J. Radiat. Biol.; 24: No. 1, 59-72(Jul 1973).

Human adenovirus type 2 was irradiated with uv-light, and the radiosensitivity of several viral functions was determined and correlated with the damage in the viral DNA. The D_{37} for plaque formation and clone inhibition was found to be 2.1×10^3 erg/mm^3 and 6.4×10^3 erg/mm^2, respectively. Thymine dimers, cross-links and single-strand breaks were detected in the viral DNA. The fraction of thymine present as dimer was 1.9×10^{-6}/erg/mm^2, and the number of uv-induced single-strand breaks was 21/erg/mm^2/10^{12} daltons. An average of 30 dimers and one single-strand break was induced per lethal hit as measured by plaque formation. The addition of caffeine to the plaquing medium was found to reduce the survival of uv-irradiated virus, suggesting the possibility of a host-mediated repair mechanism. (auth)

30057 USE OF ^{60}Co GAMMA IRRADIATION AGAINST SOME POSTHARVEST DECAY PATHOGENS OF CITRUS FRUIT IN TURKEY. Mahmood, T. (Ege Univ., Izmir, Turkey). Pak. J. Sci. Ind. Res.; 15: No. 4-5, 268-271(1972).

Investigations were carried out in vivo and in vitro, on some decay pathogens, to determine the possibility of using ^{60}Co gamma irradiation to extend the shelf and storage life of citrus fruit. Tests in vivo showed that a dose of 200 to 300 krad was effective for decay control incited by Penicillium italicum, P. digitatum, Phytophthora citrophthora, P. parasitica, and Geotrichum candidum. The problem of organoleptic changes was mostly encountered when exploiting these dosages in case the quality of the fruit was poor, whereas in good quality fruit the dosages were efficient and remarkably increased the storage and shelf life. However, a low dose of 100 to 200 krads has been suggested. In in vitro tests the germination of the spores of decay pathogens and their rates were correspondingly influenced with the increasing amount of gamma dose delivered. A higher dose caused a depletion in vitamin C content of citrus fruit. (auth)

30058 DO ULTRAVIOLET-INDUCED MUTATIONS TO STREPTOMYCIN RESISTANCE EXHIBIT SUSCEPTIBILITY TO MUTATION FREQUENCY DECLINE? Witkin, E. M.; Wermundsen, I. E. (Rutgers - The State Univ., New Brunswick, NJ). Mutat. Res.; 19: No. 2, 261-264(Aug 1973).

Incubation of Escherichia coli for one hr in minimal medium prior to plating on amino acid-enriched agar resulted in reduction of the yield of uv-induced streptomycin-resistant mutations. Kinetics of the mutation frequency decline were followed as a function of time in minimal medium after uv irradiation from 0 to 60 min before plating. Essentially all of the decline in frequency of suppressor mutations was irreversibly determined after 20 min of incubation. Addition of acriflavine to the minimal medium at the start of incubation inhibited the decline of suppressor mutations. (HLW)

30059 INDIRECT ULTRAVIOLET INDUCTION AND CURING IN E. COLI CELLS LYSOGENIC FOR BACTERIOPHAGE LAMBDA. Benbow, R. M. (Medical Research Council, Cambridge, Eng.); Devoret, R.; Howard-Flanders, P. Mol. Gen. Genet.; 120: No. 4, 355-368(1973).

Indirect ultraviolet induction of prophage lambda occurs when lysogenic E. coli K12 cells are mated with ultraviolet-irradiated donor strains carrying a transmissible episome such as F lac$^+$. Indirect induction occurs in wild type, uvrA, recB recipient lysogens, but not in recA lysogens. When nonpermissive lysogens carrying prophages lambda susO or lambda susP are similarly mated, the defective prophages are induced and indirect curing takes place. Although indirect induction is independent of the capacity of the lysogen for repair by pyrimidine dimer excision, indirect curing (and hence indirect induction) is subject to photoreactivation when the recipient lysogen is exposed to visible light after mating. This confirms that the structure initiating indirect ultraviolet induction is a damaged transferred episome consisting of one DNA strand containing ultraviolet photoproducts and a newly synthesized discontinuous DNA strand such that pyrimidine dimers remain in single-stranded regions. F-lac$^+$ recombinants are formed in either nonlysogenic or lysogenic Lac$^-$ cells receiving damaged F-lac$^+$ episomes from ultraviolet irradiated F-lac$^+$ donors. Lambda prophage induction occurs more frequently in zygotes that form Lac$^+$ recombinants than in zygotes that remain Lac$^-$. In contrast, cells receiving intact (undamaged) episomes are converted to F lac$^+$ secondary donors, but are rarely induced or cured. (auth)

30060 RADIOSENSITIVITY OF THE SINGLE DEVELOPMENTAL STAGES IN THE REPRODUCTION CYCLE OF THE BACTERIOPHAGE PHI X 174 AFTER ^{60}Co GAMMA IRRADIATION. Schoen, M. Karlsruhe, Ger.; Univ. Karlsruhe (1973). 58p. (In German).

Thesis.

The present thesis investigates the radiosensitivity of the single developmental stages in the reproduction cycle of the bacteriophage PHI X 174 up to the daughter DNA synthesis. Escherichia coli H 513 cells were infected with ^{60}Co-gamma-irradiated, ^{32}P-labeled phages PHI X 174 am 3. Tritium-labeled thymine was added to the culture medium used for this purpose in order to be able to distinguish between the DNA synthesis products and the DNA of the ^{32}P-labeled phages. The replication process was interrupted. The cells were broken up by lysozyme and their constituents were centrifugated in the saccharose gradient and analysed by means of radioactivity measurements and biological tests. The relative radiosensitivity (related to the radiosensitivity of plaque formation) increases with the developmental stages. Adsorption is but little affected. The injection of the phage DNA is assumed to be disturbed by the occurrence of strand breaks. The formation of the parental RF which is done by the polymerase of the host itself occurs in two-thirds of injected, inactivated DNA. The relative radiosensitivity observed for the fixation of the parental RF to the site of replication shows that each p-RF molecule is bound to the membrane. The inactivation probabilities determined for the DNA synthesis demonstrate that the radiosensitivity of a developmental stage that requires the synthesis of phage-specific enzymes is markedly enhanced. This is thought to be particularly true for the PHI X 174 phage as its genome is transcribed as a whole. (GE)

30061 RESCUE BY CHLORAMPHENICOL AND RIFAMPICIN OF UV-IRRADIATED lon, exrA, AND recA MUTANTS OF ESCHERICHIA COLI K12. Marshall, N. J.; Gillies, N. E.; Panchapagesan, G. (Middlesex Hospital Medical School, London). Mutat. Res.; 19: No. 2, 145-152(Aug 1973).

The effect of temporary treatment with chloramphenicol or rifampicin on the survival of uv-irradiated cells of selected Escherichia coli K12 radiation-sensitive mutants was examined. Increased survival resulted for both exrA and recA mutants, and also for the unsuppressed lon mutant, but cells of the parent strain and the recB mutant were not rescued. This contrasts with the earlier finding that after exposure of the bacteria to γ rays, chloramphenicol treatment rescued the exrA and lon mutants but not the recA mutant. An exrA recA double mutant was rescued by chloramphenicol after uv radiation, but not after anaerobic ionizing radiation. Inclusion of inhibitors of uvrA governed repair, caffeine and 8-methoxypsoralen (8-MOP), in the incubation medium containing chloramphenicol, did not reduce the rescue of the exrA or recA mutants, although caffeine eliminated rescue of the lon mutant, which was itself unaffected by 8-MOP. However it was concluded that chloramphenicol rescue of the exrA and recA mutants after uv radiation was not entirely independent of the excision-repair process, since the uvrA recA and uvrA exrA double mutants were not rescued by this treatment. (auth)

30062 BIOCHEMICAL BASIS OF RADIATION-SENSITIVITY IN MUTANTS OF NEUROSPORA CRASSA. Worthy, T. E.; Epler, J. L. (Univ. of Tennessee, Knoxville). Mutat. Res.; 19: No. 2, 167-173(Aug 1973).

The available uv-sensitive mutants of Neurospora crassa were examined for their ability to excise and photoreactivate cytosine-containing dimers in vivo. All strains exhibited in vivo photoreactivation, including upr-I, which was originally thought to be deficient in photoreactivation. Two strains, uvs-2 and upr-I, were shown to be deficient in excision repair; uvs-3 was shown to contain a residual amount of excision capability. The remaining strains, uvs-I, uvs-5, and uvs-6, were normal in their ability to excise dimers. Based on these results, tentative analogies were drawn between the Neurospora mutants and the known classes of uv-sensitive mutants in E. coli. Accordingly, the N. crassa mutants were classified as uvs-I, -lon; uvs-2, -uvr; uvs-3, -uvr (rec?); uvs-5, -lon; uvs-6, -rec; and upr-I, -uvr. A comparison was made between the biochemical responses and the available published data on mutation induction in the Neurospora mutants. Although some relationships were seen between repair defects and mutation induction, too little data were available for any definitive conclusions. (auth)

30063 INCISIONS IN ULTRAVIOLET-IRRADIATED CIRCULAR BACTERIOPHAGE LAMBDA DNA MOLECULES IN EXCISION PRO-

FICIENT AND DEFICIENT LYSOGENS OF E. coli. Seeberg, E.; Johansen, I. (Forsvarets Forskningsinstitutt, Kjeller, Norway). Mol. Gen. Genet.; 123: No. 2, 173-184(1973).

The breakage of closed covalent lambda DNA molecules in lysogenic host cells after ultraviolet irradiation was investigated. In repair proficient host cells, incisions are introduced immediately following irradiation. A steady-state of strand interruptions is observed within 20 to 50 sec after irradiation, where the number of broken molecules is dose dependent for doses up to 600 ergs/mm^2. No ultraviolet promoted strand breaks were observed in uvrA or uvrB lysogens, in accordance with previous results obtained by Shimada, et al. In contrast, uvrC mutants have the ability to form breaks in superinfecting lambda DNA molecules after ultraviolet irradiation. The ultraviolet specific endonucleolytic activity observed in uvrC host cells differs from that observed in uvr$^+$ host cells in that the first break is introduced at least 15 times slower, that for doses below 300 ergs/mm^2 the number of strand breaks is higher and that the dose dependence terminates at a lower dose. The possible function of the uvrC gene product in the repair is discussed. (auth)

30064 INVESTIGATION OF UV-INDUCED MUTAGENESIS IN BACILLUS SUBTILIS. I. Clonal Analysis of Mutant Colonies Formed by Irradiated Spores. Lotareva, O. V.; Filippov, V. D. (Inst. of General Genetics, Moscow). Genetika; 9: No. 7, 90-96 (Jul 1973). (In Russian).

A suspension of spores of Bacillus subtilis 168 ind$^-$ was shaken with the carborundum powder in order to break up aggregates of spores into separate spores and was subsequently plated on a semiselective medium (a synthetic medium without tryptophan, enriched with 0,01% of yeast extract). Revertants grew better on this medium and formed larger colonies as compared to auxotrophs. Mutant colonies formed by non-irradiated spores were always detectable as insertions in the colonies of the initial type. Spores in which mutations were induced by high doses of uv (characterized by the rate of survival from 0.01 to 0.4%) in the resting state or in 60 min. after the beginning of germination formed large mutant colonies homogenous morphologically. They were shown by the qualitative clonal analysis to consist of mutant and auxotrophic cells. It was shown by the mutability of uv-treated resting spores that the spore uv-photoproducts are mutagenic lesions for Bac. subtilis. (auth)

30065 COMPARATIVE STUDY OF THE EFFECTS OF UV IRRADIATION UPON DIPLOID CULTURES OF YEAST DEFECTIVE AT THE RAD 3 LOCUS. Waters, R.; Parry, J. M. (Univ. Coll. of Swansea, Wales). Mol. Gen. Genet.; 124: No. 2, 145-156(1973).

The rad 3 gene of Saccharomyces cerevisiae appears to code for one of the enzymes involved in the repair of uv induced pyrimidine dimers. Haploid and diploid yeast cultures carrying different mutant alleles of the rad 3 gene show considerable variation in their responses to both uv inactivation and post uv modifying treatments such as liquid holding in basal medium and photoreactivation. Positive liquid holding recovery was shown only by those diploid cultures containing alleles that conferred the highest levels of uv resistance. The results indicate that liquid holding recovery in yeast requires the activity of the excision-repair pathway for expression. (auth)

30066 MECHANISM OF UV-REACTIVATION OF BACILLUS SUBTILIS PHAGES. Azizbekyan, R. R.; Galitskaya, L. A. (Inst. of Genetics of Microorganisms, Moscow). Genetika; 9: No. 7, 85-89(Jul 1973). (In Russian).

The possibility of uv-reactivation of the phages of Bacillus subtilis was investigated. It is shown that a preliminary irradiation of the host bacteria with a small dose of uv increases the rate of survival of irradiated phages AR1, AR9, and SP-50. Since base composition of DNA of AR9 phage is significantly different from that of the host bacteria, a conclusion is drawn that the so-called recombination hypothesis of the mechanism of uv-reactivation, assuming, as an indispensable pre-requisite, a considerable degree of homology between DNAs of the phage and of the host bacteria, can not be applied for the explanation of the results obtained, at least of those relating to the phage AR9, the composition of DNA bases of this phage and of the host bacteria being G + C = 27.7 and 44.8, respectively. (auth)

30067 INHIBITION OF THE uv-IONIZING RADIATION SYNERGISM IN ESCHERICHIA COLI B/r BY LIQUID HOLDING BETWEEN THE TWO IRRADIATIONS. Okuda, A. (Tottori Univ., Yonago, Japan). Photochem. Photobiol.; 18: No. 4, 335-337(Oct 1973).

A study was made of the inhibition of the uv-ionizing radiation synergism in Escherichia coli B/r by liquid holding between the two irradiations. Pre-exposure to uv radiation at 450 ergs mm^{-2} appeared to increase the slope of the exponential electron survival curve over an electron range of 0 to 20 Krads. When the cells were held in buffer for up to 3 hr (liquid-holding recovery) prior to plating and between irradiations, the slope of the electron survival curve decreased to an intermediate curve. Liquid-holding for 3 hr before electron irradiation, but without uv preirradiation, did not affect the electron survival curve. Survival appeared to increase as holding time increased. If the treatments were followed by illumination, the survival fraction was almost constant irrespective of holding time, but the photoreversibility of synergism decreased as the holding time increased. The inhibitory effect of liquid-holding an uv-ionizing radiation synergism was also observed when the order of irradiations was reversed. (UK)

30068 CROSS SENSITIVITY OF MONO- AND BIFUNCTIONAL ALKYLATING AGENTS OF THREE RADIATION-SENSITIVE SACCHAROMYCES MUTANTS. Laskowski, W.; Lehmann Brauns, E. (Freie Univ., Berlin). Biophysik; 10: No. 1, 51-59(1973).

The inactivation of three radiation-sensitive haploid Saccharomyces mutants, as well as that of corresponding homozygous diploid mutants, following treatment with the bifunctional alkylating agents diepoxybutane (DEB) or the monofunctional alkylating agents methylmethane-sulfonate (MMS) or methylnitrosoguanidine (MNG) was investigated. Sensitivity to DEB was correlated with sensitivity to ultraviolet light. The response to MMS or MNG treatment was more complex. The most UV-sensitive haploid and diploid mutants were as resistant as wild type after MMS or MNG treatment. Those mutants with an intermediate UV sensitivity were also sensitive after MMS treatment, independent of their state of ploidy. After exposure to MNG, however, a characteristic difference appeared between the sensitivity of the two intermediate sensitive haploids and the corresponding diploids. A model is discussed, interpreting the results obtained as an indication of the existence of at least three different repair mechanisms in Saccharomyces. (auth)

30069 EFFECT OF RADIATION SENSITIZING AND PROTECTIVE AGENTS ON THE POST-IRRADIATION SYNTHESIS OF DNA BY MEMBRANE COMPLEXES OF ESCHERICHIA COLI B/r. Cramp, W. A.; Fraval, H. N. A.; Collins, J. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 24: No. 2, 161-168(Aug 1973).

Measurements were made of the synthesis of DNA by membrane-DNA complexes extracted from Escherichia coli B/r that had been sensitized to or protected against the lethal effects of ionizing radiation by irradiating the bacteria with 7 MeV electrons in the presence of indane, trione, acriflavine, thiourea, or β-mercaptoethanol. Pre-irradiation treatment of the bacteria with cuprous copper was also used as a method of sensitization. Acriflavine and β-mercaptoethanol interfered either with the lysis procedure for preparation of the membrane complex or with the DNA synthetic reaction itself. When agents were used that sensitize only in anoxic conditions (indane, trione, copper compounds), there was no accompanying sensitization of the DNA-membrane system, but cells protected against cell-killing with thiourea, an agent that protects more effectively in aerated conditions of irradiation, yielded DNA-membrane complexes that were more resistant to radiation. (auth)

30070 EFFECT OF γ IRRADIATION ON THE SYNTHESIS OF RIBOSOMAL RNA AND RIBOSOMAL SUBPARTICLES IN ESCHERICHIA COLI. Fujita, H.; Miyakoshi, M. (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 56: No. 1, 186-200(Oct 1973).

Effects of γ-irradiation on the synthesis of ribosomal RNA and on the concomitant formation of ribosomal subparticles in Escherichia coli cells were studied. The amount of RNA species synthesized was exponentially decreased with increasing doses. While the size of these RNA molecules was nearly normal and accumulation of prematurely terminated molecule was not detected, a larger amount of the RNA species having sedimentation coefficients of 17 S and 23.5 S was present in irradiated cells than was in unirradiated control cells. This was accounted for by the retardation of the maturation process from the precursor form to the mature form. The sequential assembly of ribosomal subparticles was also delayed by irradiation. This retardation was more prominent in the formation of 50 S subparticles than in the formation of 30 S. It was concluded that irradiation affects the synthesis of rRNA and ribosomal particles in a similar fashion as do antibiotics or starvation of amino acids. (auth)

30071 REQUIREMENT OF A FUNCTIONAL GENE 32 PRODUCT OF BACTERIOPHAGE T4 IN UV REPAIR. Wu, J. R.; Yeh, Y. C. (Univ. of Arkansas, Little Rock). J. Virol.; 12: No. 4, 758-765(Oct 1973).

A temperature-sensitive mutation in gene 32 was used to study the role of gene 32 protein in the repair of uv-damaged DNA of bacteriophage T4. It was possible to distinguish between repair and replication of DNA at 33°C. At this temperature, DNA repli-

cation continued, and the intracellular DNA was stable. In contrast, no significant repair of uv-damaged DNA was observed even 40 min after the irradiation. Therefore, it was concluded that the defect in the repair mechanism at this temperature is not a simple consequence of the defect in DNA replication but that gene 32 apparently has an independent role for DNA repair. It was reported previously that gene 32 product is required for both T4 DNA replication and genetic recombination. In addition to these findings, this study has given direct evidence that, in vivo, this protein is also essential for the uv repair mechanism. (auth)

Radiation Effects on Plants

Refer also to abstract 29839.

30072 (CONF-710501-P2, pp 961-971) EFFECTS OF IONIZING RADIATION ON PROCESSES INFLUENCING TOLERANCE OF TREE SEEDLINGS. Harris, W. F.; Witherspoon, J. P. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Effects of acute doses (up to 500 rads) of fast neutrons on dormant seedlings of yellow poplar and silver maple, which were grown postirradiation in light environments of 100, 50, and 25% of full sunlight, indicated specific mechanisms that would reduce seedling tolerance to normal environmental stresses, thus increasing apparent radiosensitivities of higher plants as predicted from nuclear parameters. Morphological and physiological responses were monitored periodically. Morphological responses varied considerably along a gradient of reduced light, except for bud mortality. Physiological responses were dependent on structural modifications. Photosynthetic capacity of irradiated seedlings was modified by reduced rates of photosynthesis per unit area, early senescence of foliage of irradiated seedlings, and annual variation in recovery of leaf area development. As a consequence of reduced photosynthate accumulation, root production was decreased, occurrence of root production was delayed, and concentration of storage carbohydrates was reduced. Transpiration rates of excised, aberrant yellow poplar foliage were 1.6 times greater than those of normal foliage. Previously observed increases in drought susceptibility of radiation-damaged plants are postulated to result from increased water requirement of tissue and decreased capacity to supply water because of altered leaf histology and resultant imbalance of leaf area-root biomass ratios following radiation damage to developing buds and leaves. (auth)

30073 (CONF-710501-P2, pp 972-977) SEED YIELD AND QUALITY IN WHITE SPRUCE CROSS-POLLINATED WITH GAMMA IRRADIATED POLLEN. Rudolph, T. D. (North Central Forest Experiment Station, Rhinelander, WI). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Pollen from three white spruce trees was gamma irradiated at 16 different exposures ranging from 0 to 28,800 R and used in cross-pollinations on four clones. Pollen radiosensitivity determined from seed yield and quality ranged from an LD_{50} of 5903 to 9097 R, varying with the end point used and the parents involved in the cross. Genotypic differences were found in pollen radiosensitivity among both male and female parents and due to an interaction between the parents. Pollen radiosensitivity (LD_{50}) determined from seed produced from crosses on four trees showed a negative correlation with seed yield and quality produced from crosses with nonirradiated pollen on the same female parents. (auth)

30074 (CONF-710501-P2, pp 978-982) FACTORS AFFECTING THE RADIOSENSITIVITY OF FRAXINUS AMERICANA L. SEEDLINGS AND SEED. Heaslip, M. B. (Morehead State Univ., KY). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Samples of 20 first-year Fraxinus americana L. seedlings exposed to 0.0, 2.8, 5.6, 8.6, and 11.4 kR of gamma rays while dormant (December 1967) or as the buds were breaking (April 1968) were planted in a secondary forest. Greater than 50% of the dormant seedlings survived all exposure doses, but less than 30% of the active seedlings survived doses of 5.6 kR or greater. In this native habitat, seedling growth rate decreases with increasing exposure dose. Fraxinus americana seed is also relatively resistant to gamma rays, but the RBE of fast neutrons to gammas is higher than it is for more gamma-sensitive species. Highly significant neutron gamma interactions of seed exposed to 16 combinations of fast neutrons and gammas indicate that the effects of fast neutrons and gammas are not additive. Increasing water content of seed exposed to fast neutrons or gammas significantly decreased gamma sensitivity and increased fast neutron sensitivity. This difference could account for the effects of these two types of radiation not being additive. Excess seed stored at 2 to 5°C for three years before planting in 1969 exhibited the same general pattern of radiosensitivity. (auth)

30075 (CONF-710501-P2, pp 1007-1014) PREDICTED EFFECTS OF CHRONIC GAMMA IRRADIATION ON NORTHERN FOREST COMMUNITIES. Zavitkovski, J.; Rudolph, T. D. (Inst. of Forest Genetics, Rhinelander, WI). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

A prediction of the effects of gamma radiation (growing-season exposure) on natural northern forest communities was developed based on vegetation survey; determination of interphase chromosome volumes (ICV) of the most important plan species; and reported relationships between ICV and radiosensitivity. ICV's of angiosperm tree, shrub, and ground vegetation species ranged from about 1.5 to 7.3 μ, and those of gymnosperm trees from 30.2 to 52.0 μ^3. Lichens and bryophytes are common, and because of their high radioresistance should survive in the innermost zone. A Carex zone with some Lycopodiaceae should develop around this innermost zone followed by a zone dominated by Corylus cornuta and several species of Ericaceae. The transition between the third and fourth zone may be very diverse, with Corylus and Amelanchier, some Polypodiaceae, and perhaps some resistant tree genera such as Tilia, Fraxinus, and Prunus. Sprouts from roots of killed Populus tremuloides trees also may develop and survive here. Beyond this, a zone dominated by Betula, Populus, and Acer in its inner part with some Quercus borealis at the outer edge should become evident, but may not be too different from the pretreatment forest because only gymnosperms will be selectively removed. Living gymnosperms will delineate the outermost zone of essentially unchanged northern forests. (auth)

30076 (FRNC-R-19, pp 141-144) IMMEDIATE EFFECTS OF A SUB-ACUTE GAMMA IRRADIATION ON THE PHOTOSYNTHESIS OF UNICELLULAR ALGAE. Ehrhardt, J. P.; Leguay, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Investigations of the effect of γ irradiation on photosynthesis phenomena in three different unicellular algae, selected in such a way as to obtain general results applicable to algae, are presented. In order to obtain a 10% inhibition in the release of oxygen, it is necessary to utilize very large doses (300 kilorads or more). The dose necessary to produce a 50% inhibition caused radiosterilization in cultures of the three organisms studied. This dose corresponds to the 75/30 days LD. The radioresistance of the photosynthesizing processes is thus greater than that of the cellular multiplication mechanisms. (FR)

30077 (IAEA-R-476-F) INDUCTION OF MUTATIONS IN RICE BY RADIATIONS COMBINED WITH CHEMICAL MUTAGENS. Part of a Coordinated Programme of Research on the Use of Induced Mutations for Rice Improvement. Final Report, 1 January 1967–31 December 1971. Ando, A. (International Atomic Energy Agency, Vienna (Austria)). Feb 1972. 17p. INIS.

Biological effects of the treatment combinations of gamma-rays, chemical protectants such as cysteine and glutathione, and chemical mutagens such as EO, EI, DES, EMS, NMH, and NEH, on the dormant rice seeds were compared and analyzed and some useful mutant lines were selected from these combined treatments. Statistical analysis by means of the sign test indicates that the post-treatment with cysteine for 45 hours was rather prejudicial to the various M_1 characters of the irradiated seeds and that the post-treatment for 30 hours was the most protective. The treatment with glutathione for 30 hours seemed to be prejudicial and that with cysteine for 24 hours did not show any effects. The chlorophyll mutation spectrum, calculated on albina, viridis, and others was not different among gamma treatments in different years, the post-treatments with cysteine and glutathione, the treatments with various mutagens used (gamma rays, EO, EI, DES, EMS, and NEH), and the combined treatments of gamma rays and chemical mutagens, but was different among the combined treatments of gamma rays, sulfhydryl compounds, and chemical mutagens. The first flowered panicles showed a lower segregation ratio and higher chlorophyll mutation frequency on the basis of the M_1 panicles than the later flowered panicles. (INIS)

30078 UTILIZATION OF RADIOACTIVITY IN FOOD PRODUCTION. Salez, N. Usine Nouv., Suppl.; 285-307(May 1972). (In French).

New species of cereals and fruit were obtained by radiation-

induced mutations. Irradiation and isotopic labeling were also used for the selection of fertilizers, protection of plants and cattle from insects (sterile male technique, insect dispersal), measurement of soil humidity for irrigation purposes, and food preservation. (FR)

30079 COMPARISON OF THE CYTOGENETIC ACTIVITY OF N-ETHYL-N-NITROSOUREA AND GAMMA RADIATION. Uhlik, J. (Univ. of Agriculture, Prague). Genet. Slechteni; 8: No. 2, 91-96 (Apr 1973). (In Czech).

The cytogenetic activity of N-ethyl-N-nitrosourea and gamma radiation was evaluated in the meristematic cells of the rootlets of the treated lentil seeds. Doses from 5 to 19 kR were used to irradiate the seeds with gamma rays. N-ethyl-N-nitrosourea in concentrations from 0.00125 to 0.0275% was used to treat 31 g of seeds in 100 ml of solution at 18°C for 20 hrs., with 60-minute washing. Larger differences in the activity of the two mutagens appeared (in most of the characters under study) only after the application of medium and higher doses. The effect of N-ethyl-N-nitrosourea was characterized by high similarity of activity of low concentrations, whereas after the exposure to medium and higher concentrations the effect of chemomutagens showed a linear increase depending on concentration. The effect of gamma radiation was characterized by a very low increase of the values after the exposure to medium-level doses, as distinct from other doses. This concerns the proportion of cells with chromosome aberrations, proportion of cells with only one type of chromosome aberrations, and the overall number of chromosome aberrations per one cell. Linear dependence of activity on the dose or dependence expressed by a two-peak curve were observed in other characters. The cells, together with both types of chromosome aberrations (fragments and bridges) were induced only after exposure to doses higher than 11 kR and 0.0125%. The data allow for direct comparison of the cytogenetic activity of both mutagens under study with the activity of thermal and fast neutrons. (auth)

30080 TETRASOMY IN GAMMA IRRADIATED GRAM (CICER ARIETINUM L.). Thombre, P. G.; Atale, S. B. (College of Agriculture, Parbhani, India). Sci. Cult. (Calcutta); 39: No. 4, 186-188(Apr 1973).

What appears to be a case of tetrasomy in irradiated gram (Cicer arientinum L.) is reported. Air dried seeds of several varieties were exposed to 15, 30, and 45 KR doses of γ radiation and meiosis was studied in randomly fixed flower buds of subsequent generations. The occurrence of nine bivalents at metaphase I and their subsequent regular disjunction points to the fact that the extra two chromosomes are complete homologs of each other. This suggests tetrasomy (2n + 2) rather than double trisomy (2n + 1 + 1). (ERB)

30081 BIOPHYSICAL PROPERTIES OF 3.9-GeV NITROGEN IONS. III. OER and RBE Determinations Using Vicia Seedlings. Hall, E. J.; Kellerer, A. M. (Columbia Univ., New York). Contract AT(11-1)-3243. Radiat. Res.; 55: No. 3, 422-430(Sep 1973).

Seedlings of Vicia faba were used as a test system to investigate the radiobiological properties of a beam of 3.9-GeV nitrogen ions. Samples were irradiated on the entrance plateau and in various positions close to the Bragg peak of the depth-dose distribution. The oxygen enhancement ratio (OER) was found to be 1.55 to 1.65 at the Bragg peak, but had a value indistinguishable from that of x rays at all other positions in the beam. The relative biological effectiveness (RBE) is a function of dose, and therefore of the level of biological damage. For 50% growth inhibition the RBE is between 1 and 1.9 on the entrance plateau, and is about 6 at the Bragg peak. In the region a few millimeters upstream of the Bragg peak the RBE remains nearly constant in spite of a rapid variation of average LET. Over the same region the OER rises rapidly from the low value determined at the peak (1.55 to 1.65) to the value characteristic of conventional x rays (2.5 to 3). (auth)

30082 BIOPHYSICAL PROPERTIES OF 3.9-GeV NITROGEN IONS. V. Determinations of the Relative Biological Effectiveness for Somatic Mutations in Tradescantia. Underbrink, A. G.; Schairer, L. A.; Sparrow, A. H. (Columbia Univ., New York). Contract AT(11-1)-3243. Radiat. Res.; 55: No. 3, 437-446(Sep 1973).

Young inflorescences of Tradescantia clone 02 were irradiated with 3.9-GeV nitrogen ions from the Princeton Particle Accelerator. The inflorescences were irradiated at several positions along the nitrogen depth-dose curve. Petals and stamen hairs were scored for pink mutations. The slopes of the dose-response curves from each position on the depth-dose curve were linear with dose. RBE was found to decrease with increasing dose. Maximum RBE values, relative to 250-kVp x rays were determined at each position. The lowest RBE (3.8) occurred upstream in the beam of the pre-Bragg plateau. An RBE max of 5.6 was found behind the Bragg peak. In two experiments the RBE max was found to be 14.3 and 15.6 at the Bragg peak, while a higher RBE (18.5) was found 2 mm in front of the Bragg peak. This latter effect was attributed to possible excess ionization density at the Bragg peak. (auth)

30083 BIOPHYSICAL PROPERTIES OF 3.9-GeV NITROGEN IONS. VI. Interpretation of Results. Kellerer, A. M.; Rossi, H. H. (Columbia Univ., New York). Contract AT(11-1)-3243. Radiat. Res.; 55: No. 3, 447-456(Sep 1973).

Biological data obtained on Vicia faba, Tradescantia, and mammalian cells with a 3.9-GeV nitrogen ion beam are related to microdosimetric measurements. The relative biological effectiveness near the Bragg peak of the depth-dose curve can be explained on the basis of the microdosimetric data and the theory of dual radiation action. A comparison is performed with the results obtained on the same biological systems with monoenergetic neutrons, and essential agreement is found with earlier conclusions derived from the comparison of track-segment experiments and neutron irradiations. The oxygen-enhancement ratio for the nitrogen ions is higher than expected from the microdosimetric data; this is taken as an indication that the oxygen effect may at least partly depend on the energy concentration over distances of the order of nanometers. The implications of the results to the use of heavy ions in radiotherapy are considered. (auth)

30084 CYTOGENETIC ANALYSIS OF SEEDS OF THE DIPLOID AND AUTOTETRAPLOID CREPIS CAPILLARIS AFTER FLIGHT ON KOSMOS-368. Platonova, R. N. Kosm. Issled.; 11: No. 3, 478-481(1973). (In Russian).

A cytological analysis was made of the seeds of the diploid (2n = 6 chromosomes) and autotetraploid (4n = 12 chromosomes) of Crepis capillaris after its exposure to the factors of space flight. Some increase of the frequency of chromosome rearrangement was observed in the cells of the rootlets of the 2n and 4n forms. Change of the ratio of the different types of chromosome rearrangements was also observed. A comparison was made of the data obtained in the diploid condition with the tetraploid both with spontaneous and inductive mutagenesis. (tr-auth)

30085 EFFECT OF GAMMA IRRADIATION ON THE ULTRAFINE ORGANIZATION OF MITOCHONDRIA OF COTTON PLANTS WITH DIFFERENT RADIOSENSITIVITIES. Arslanova, S. V. (Inst. of Experimental Biology of Plants, Tashkent). Uzb. Biol. Zh.; No. 3, 6-9(1973). (In Russian).

During irradiation of seed with doses of 10 kr the ultrafine structure of mitochondria in early-ripening 1306-DV and late-ripening S-1622 varieties of cotton was impaired. Swelling, dissolution of the internal structure, and vacuolization of the mitochondria were noted. In the variety S-1622 the mitochondria were shriveled. This is caused by the small quantity of mitochondria, their large size, and the smaller quantity of granules. Variations in the ultrafine structure of the mitochondria lead to depression of the oxidation of carbohydrate through the Krebs cycle and increase of the oxidation through the pentose phosphate cycle. (tr-auth)

30086 MORPHOLOGICAL AND ULTRA-STRUCTURAL MODIFICATIONS INDUCED BY ^{60}Co GAMMA RADIATIONS IN FESTUCA PRATENSIS. Brezeanu, A.; Titu, H. Rev. Roum. Biol., Ser. Bot.; 17: No. 4, 219-226(1972).

The results of morphological and ultrastructural investigations in Festuca pratensis plants resulting from seed irradiated with 5,000, 10,000, and 15,000 R doses are presented. At higher doses an inhibition of the differentiation and growth process of organs of the vegetative sphere (bud and ramification differentiation, culm elongation, formation of adventitious root system) takes place. Analysis of the ultrastructure of cytoplasmatic organelles in the irradiated material evidenced certain modifications of the Golgi apparatus, of mitochondria, of endoplasmic reticulum, but particularly at the level of chloroplasts, in which a reduction of the number of granules, the diminution of the number of thylacoids per granule, dilatations and elongations of thylacoids, breakings of intergranal lamellae were observed. The results are discussed in connection with personal data and with those of literature concerning the influence of radiations on the tillering and ultrastructure of cellular organelles in other higher plants. (Rom. Sci. Abstr.)

30087 RADIOSENSITIZATION OF BLUE-GREEN ALGA ANACYSTIS NIDULANS BY CHEMICAL COMPOUNDS. Dmitriev, A. P.; Grodzinskii, D. M. (Inst. of Plant Physiology, Kiev). Stud. Biophys.; 35: No. 3, 157-163(1973). (In German).

Experiments were carried out on the sensitization of the blue-green alga Anacystis nidulans to gamma irradiation by monoiodoacetic acid (IA), p-chloromercuribenzoate (CMB) or ninhydrin (N). Plating technique was used. Irradiations were performed under anoxic or aerobic conditions. Radiosensitizers were present at non-toxic low concentrations and the time of preincubation was 1.5 hours. Radiosensitizing effects were observed when cells were

irradiated in the presence of IA or CMB, being greatly in excess of oxygen effect. Ninhydrin did not have a marked sensitizing action. (auth)

30088 GAMMA IRRADIATION INDUCED EARLY GROWTH STIMULATION IN SOME CUCURBITS. Siddiqui, S. H.; Mujeeb, K. A. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Stimulation Newslett.; No. 4, 12-17(1972).

The present studies were carried out to assess gamma-irradiation-induced growth stimulation in some members of the family Cucubitaceae in the initial growth stages. Dry, one-year-old seeds of seven cucurbits were subjected to acute gamma irradiation dosages ranging from 2.0 to 71.0 kR. from a 250 Curie cobalt-60 source. The cucurbits were: Momordica charantia (Bitter gourd), Lagenaria vulgaris (Bottle gourd), Lagenaria vulgaris (Round gourd), Luffa aegyptiaca (Sponge gourd), Cucurbita pepo (Sweet gourd), Cucurbita pepo (Pumpkin) and Cucumis sativus (Cucumber). There were 100 seeds per treatment. The treatment was completely randomized. Germination count and seedling height observations were recorded 14 days after 50% germination in control. Average seedlings height (percent of control) provided data for indications of early growth stimulation. Overall negative trends for average height are more markedly manifested at the higher dosages. Simulation is apparent from 2.0 kR. up to 32.0 kR., with varied responses, depending on the kind of plants. (GE)

30089 EFFECT OF X-RAY IRRADIATION ON FLOWERING RESPONSE OF SOME CROP PLANTS. Bhargava, S. C.; Sirohi, S. (Indian Academy Research Inst., New Delhi). Indian J. Agr. Sci.; 42: No. 5, 389-392(1972).

A study was made of the effect of acute x-ray treatments at pre-sowing stage on the flowering response of biloxi soybean (Glycine max (L.) Merr.), an obligate short-day plant (SDP), and on the growth and flowering of 2 species of a facultative SDP sorghum and their hybrids. Exposures of 250,500, 1,000, and 2,000 R to seeds caused marked stimulation of flora initiation in biloxi soybean plants, but this took place only under SD-inductive conditions. In sorghum the hybrid seeds were more sensitive to x-ray exposure than their parental lines, especially in flowering. The results are interpreted and discussed in terms of interference by x-ray irradiation on the chain of reactions and their rates, which are responsible for floral expression. (Indian Sci. Abstr.)

30090 BIOLOGY OF SELECTED MUTANTS OF HORDEUM VULGARE L. (VAR. DISTICHON 1. NUTANS) AGAINST A BACKGROUND OF RADIOSENSITIVITY AND MUTABILITY OF PARENT VARIETY. Pala, J. (Instytut Hodowli i Aklimatyzacji Roslin, Radzikow, Poland). Hodowla Rosl., Aklim. Nasien.; 16: 175-249 (1972). (In Polish).

An analysis of barley mutants showed that irradiation of plants with a heterozygous genotype gave the best results. Optimum doses for inducing chromosome aberrations were 15 kR of gamma rays and 300 rads of fast neutrons. Characteristics of 12 barley mutants induced by different gamma doses are described. Some mutants were more resistant to Erysiphe graminis than the parent variety and higher yields were obtained in some mutants. It was concluded that gamma irradiation resulted in improvement of agricultural qualities and increased commercial value of crops. (HLW)

30091 EFFECT OF DIFFERENT TERMS OF THE STORAGE OF BARLEY SEEDS ON CHANGES IN THE SPECTRUM OF CHROMOSOME ABERRATIONS INDUCED BY GAMMA IRRADIATION (METAPHASE TECHNIQUE). Gilyarovskaya, T. T. (Inst. of General Genetics, Moscow). Genetika; 9: No. 7, 12-20(Jul 1973). (In Russian).

The effects of different terms of storage of barley seeds on the total amount and the spectrum of chromosome aberrations induced by gamma irradiation are studied. At longer terms of storage of the seeds exposed to gamma irradiation at a dose of 10 krad, variations in the total mutation rate were observed. Examination of the spectrum of chromosomal structural rearrangements showed that the storage affected not only the total amount of rearrangements, but their spectrum as well. The study confirmed the hypothesis that the majority of cells in barley root meristem was at the presynthetic phase (G_1), since the overwhelming majority of rearrangements observed were of the chromosomal type. (auth)

Radiation Effects on Animals

Refer also to abstracts 30026, and 30081–30083.

30092 RECOVERY FROM GENETIC RADIATION DAMAGE IN HIGHER FORMS. Tazima, Y. (National Inst. of Genetics, Mishima, Japan). Saibo Seibutsugaku Shinpojtumu; 23: 19-24 (1972). (In Japanese).

Recovery from radiation-induced damages can be demonstrated by means of split dose irradiation. With this method, the recovery from sublethal damages, the restitution of chromosome breakage, and the repair in premutational damages were elucidated. A split dose irradiation, however, often enhances the mutation frequency, presumably due to the synchronization of the cell cycle. By irradiating silkworm spermatids, in which DNA synthesis no longer takes place, we were able to demonstrate the repair in premutational damages. Another method to demonstrate the recovery process is the treatment of cells with metabolic inhibitors after irradiation. The significance of O_2 and/or N_2 posttreatment in radiation mutagenesis has been extensively worked out by Sobels and his group. Our data on silkworm spermatids suggest that premutational damages inflicted on a single strand DNA are more likely to be repaired than those produced on a double strand DNA. For the elucidation of mechanisms underlying the repair of genetic damages, an extensive body of data was accumulated and remarkable progress was achieved in our knowledge so far as the repair of uv-induced damages in microorganisms are concerned. However, information of the similar kind are not readily obtainable for higher forms of biological complexity. A method applicable for this purpose is the combination of metabolic inhibitor treatment either with a single or split dose irradiation. Another method is to compare the reparability between sensitive and normal strains. The data thus far obtained are summarized. A conclusion could be hardly drawn from the results whether a common mechanism exists between rejoining of strand breaks or unscheduled synthesis of DNA and restitution of chromosome breaks or repair in premutational damages. Nevertheless, it seems to be probable that protein synthesis is required for the restitution of chromosome breaks and repair in premutational damages. (auth)

Man

Refer also to abstracts 29949, 30007, and 30028.

30093 (ORNL-TM-4026) DOSE ESTIMATIONS FOR THE HYPOTHETICAL USE OF NUCLEARLY STIMULATED NATURAL GAS IN THE CHEROKEE STEAM ELECTRIC STATION, DENVER, COLORADO. Moore, R. E.; Barton, C. J. (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

Whole-body radiation doses to man due to tritium were estimated for hypothetical exposures to stack gases discharged from the Cherokee Steam Electric Station in the Denver area burning 94 million cubic feet per day of nuclearly stimulated natural gas containing 10 pCi per cm^3 of tritium. The highest dose that might be received by any person outside the plant area was estimated to be 0.0056 millirem/year. This value includes 0.0047 millirem/year estimated by use of computer program, STACKDOSE 2, to result from the initial exposure to the plumes from the stacks. STACKDOSE 2 calculates the tritium concentration every 100 meters from the plant stacks in the predominant wind direction and the corresponding dose from inhalation and skin absorption of tritiated water vapor (HTO). It also identifies the location of maximum exposure. An additional 0.009 millirem/year was estimated for exposures due to residual tritium repeatedly swept over the area by wind reversals that occur almost daily in the Denver area. The total dose to the population of 1.6 million people was estimated to be 3.0 man-rems/year, of which 1.6 man-rems/year resulted from the initial plume exposure and the balance from exposures due to wind reversals. A simple modification of STACKDOSE 2, called STACKMANREM, was used to calculate the dose from the initial plume exposure, but more sophisticated programs, BLOWBACK 1 and 2, were required to estimate the dose contribution due to wind reversals. (auth)

30094 ESTIMATION OF THE GAMMA-RAY NATURAL BACKGROUND RADIATION DOSE TO AN URBAN POPULATION IN WESTERN AUSTRALIA. Yeates, D. B. (Univ. of Toronto); King, B. E. Health Phys.; 25: No. 4, 373-379(Oct 1973).

A survey was carried out in 1970 of the natural γ background in Perth the State Capital of Western Australia. Dose rates were determined using a portable high pressure ionization chamber. The contribution of cosmic radiation to the chamber ion current was deducted from each reading. Locations of measurement were chosen to permit representative data to be obtained over the important geological structures, and in and adjacent to houses and other areas utilized by the population. The survey revealed a wide range of γ dose rates, from the extremely low value of 0.2 μrad/hr in limestone and sand plain areas to a maximum of 35 μrad/hr over a laterite formation. The effect of building materials, pavements, and roads on the dose rate was demonstrated. The population dose was calculated using the measured dose rates, and statistical data for distribution of population and the various types of dwellings. The average dose rate determined for the population

of the Perth metropolitan area was 6.9 μrad/hr or 60 mrad/yr. The annual gonadal dose rate from external γ radiation was 48.4 mrad/yr. (auth)

30095 LUNG CANCER AMONG URANIUM MINERS IN THE UNITED STATES. Archer, V. E. (Dept. of Health, Education and Welfare, Salt Lake City); Wagoner, J. K.; Lundin, F. E. Health Phys.; 25: No. 4, 351-371(Oct 1973).

From 31st annual AMA congress; Jackson, WY (30 Aug 1971).

Excess respiratory cancer was demonstrated among all groups of uranium miners who have had more than 120 Working Level Months of radon daughter exposure. Lung cancer incidence rose with increasing exposure. Factors that might distort the exposure-response relationship were reviewed. Exposure to other agents such as cigarettes probably contributed to the excess, but these factors should not be considered in setting permissible levels. Respiratory cancers are continuing to appear at a high rate among the Study Group even though radon daughter levels have been markedly reduced and most of the Study Group have stopped mining. (auth)

30096 PATIENT SURFACE EXPOSURE DURING SPOT-FILM RADIOGRAPHY. Essenburg, A.; Campbell, E. M.; Holloway, A. F. (Manitoba Cancer Treatment and Research Foundation, Winnipeg). Health Phys.; 25: No. 5, 495-497(Nov 1973).

The exposure to the entrance surface of a patient of average thickness undergoing gastric spot-film radiography is reported. Measurements were made on 45 units, each fitted with an automatic exposure control, using a 23 cm unit density phantom. In addition to the entrance exposure the density on the film exposed during the simulated spot-film procedure was determined. A wide variation in exposure, from 270 to 2080 mR, was observed among units while the density of exposed films ranged from 0.36 to 2.2. A procedure is suggested that would result in more satisfactory radiographs and in many cases reduced exposure to the patient. (auth)

30097 AN INVESTIGATION OF THE RADIATION DOSES RECEIVED BY INDUSTRIAL RADIOGRAPHERS. Atherton, N. J. (Dept. of Employment, London). Brit. J. Non-Destruct. Test.; 15: No. 4, 112-114(Jul 1973).

A survey carried out by HM Factory Inspectorate of the radiation doses received by industrial radiographers showed that the radiation doses received by workers engaged in site radiography were significantly higher than those for workers employed in radiography in factory conditions. (auth)

30098 COMPARISON OF TWO METHODS OF PREVENTING CENTRAL NERVOUS SYSTEM LEUKEMIA. Aur, R. J. A.; Hustu, H. O.; Verzosa, M. S.; Wood, A.; Simone, J. V. (St. Jude Children's Research Hospital, Memphis). Blood; 42: No. 3, 349-357 (Sep 1973).

This controlled study of children with ALL (acute lymphocytic leukemia) was designed to determine in a prospective manner the relative efficacy and toxicity of two forms of prophylactic CNS (central nervous system) therapy for preventing CNS relapse and of periodic vincristine-prednisone pulses during multiple agent chemotherapy. Following cranial irradiation (2400 rads) plus intrathecal methotrexate, 3 of 45 patients developed CNS leukemia. Following craniospinal irradiation (2400 rads), 2 of 49 developed CNS leukemia. Craniospinal irradiation was associated with more leukopenia and interruptions of chemotherapy. Pulses were not associated with improvement of remission duration. The current choice of CNS therapy is cranial irradiation plus intrathecal methotrexate because it takes less time and may avoid demonstrated short-term side effects and possible long-term effects of spinal irradiation. (auth)

30099 MODIFICATION OF SCINTIGRAPHIC IMAGE OF LIVER AFTER HIGH ENERGY IRRADIATION. Fruehling, J.; Balikdjian, D. (Univ. Libre, Brussels). J. Belge Radiol.; 56: No. 3, 223-230(1973). (In French).

The effect of high-energy irradiation on the liver scan was studied in cases in which an important part of liver parenchyme was included in the irradiated field. Eleven cases of malignant lymphomas were studied as well as nine cases of cancer of the oesophagus, stomach, right kidney, and right suprarenal gland. Several hepatograms were realized before and after irradiation. The results show that after a dose of 3.500 rads, there is a clear effect of the irradiation on the scintigraphic picture, visualized by the important or full ablation of captation of ^{198}Au particles. The recuperation of this modification of the scintigraphic picture depends on the following factors: time elapsed between the scintigraphic examination and the end of the irradiation; dose of irradiation; administration of complementary chemotherapy; and liver alterations before radiation therapy. To avoid pitfalls, these factors should be considered before evaluation of liver scans in irradiated patients. (auth)

30100 EFFECT OF AMINAZINE ON THE GROWTH OF TRANSPLANTED MELANOMAS AND ON THEIR X-RAY IRRADIATION RESULTS. Svyatukhin, M. V.; Kovaleva, V. L. (Inst. of Experimental and Clinical Oncology, Moscow). Byull. Eksp. Biol. Med.; 76: No. 7, 81-83(Jul 1973). (In Russian).

Experiments with Harding-Passey's and B-16 melanomas were carried out. Repeated administration of aminazine in doses of 5 to 20 mg/kg resulted in a low but regularly reproduced and statistically significant inhibition of the tumors nodules. Aminazine administration before x-ray irradiation increased the melanomas growth inhibition effect produced by the irradiation by 40 to 50%. Retardation of the growth of the tumors subjected to the combined treatment was observed during two weeks after the therapeutic course completion. The results obtained demonstrated a possibility of aminazine use in the combined therapy. (auth)

30101 RECENT CONCEPTS IN EVALUATION OF EXPOSURE OF WORKERS TO RADIATION. Klener, V. (Inst. of Hygiene and Epidemiology, Prague). Prac. Lek.; 25: No. 4, 161-163 (Apr 1973). (In Czech).

Information from 10 publications (9 in English) is reviewed briefly. (TTT)

30102 UROLOGICAL COMPLICATIONS IN PATIENTS WITH CERVICAL CANCER AFTER THE ASSOCIATED RADIATION THERAPY. Alekseev, I. F.; Kovach, L. R.; Shipulina, V. A. (Medical Inst., Chelyabinsk, USSR). Vop. Onkol.; 19: No. 7, 21-26 (1973). (In Russian).

Experience with the diagnosis of complications on the part of the upper urine outflow ducts in 177 of 569 patients with cervical cancer, observed during 1 to 6 yrs. after the associated radiation therapy, was analyzed. Radioisotope renography, performed in 2 to 4 months during the first two years and twice a year subsequently, is felt to be the principal diagnostic method. The treatment of complications by means of biogenic stimulators, tissue preparations, prednisolone, antibiotics was accomplished in 155 patients under the control of isotope renography. The former proved to be ineffective only in 19 patients. Radioisotope renography performed regularly enabled to reveal complications at earlier stages than clinical methods, and to obtain more favorable results in this group of patients. (auth)

30103 NOTES ON PROTECTION AGAINST RADIATION IN THE NEIGHBORHOOD OF PATIENTS UNDERGOING RADIOISOTOPE DIAGNOSIS. Conte, L.; De Martini, M.; Martinenghi, C.; Rimoldi, E. (Curamn, Varese, Italy). Radiol. Med.; 59: No. 6, 532-536(Jun 1973). (In Italian).

Radiation doses received by personnel during ordinary diagnostic examinations with radioisotopes are illustrated in graphs and tables. Attention is drawn to the high gamma fields encountered in the vicinity of patients undergoing cerebral scanning with ^{99m}Tc. (auth)

30104 INVESTIGATION OF IMMUNOGLOBULIN LEVELS IN BLOOD SERUM OF URANIUM MINERS AFTER A HIGHER EXPOSURE TO IONIZING RADIATION. Wagner, V. (Otorhinolaryngological Lab., Prague); Andrlikova, J.; Sevc, J. pp 341-347 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The influence of 7.35×10^5 MeV WLM mean exposure of ionizing radiation on levels of immunoglobulins (Ig) was followed in the group of 35 uranium miners compared with a control group with lower exposure to mean 4.7×10^5 MeV WLM. The levels of Ig were ascertained in the group with higher exposure at the time of starting work and after 1 yr. of exposure. The Ig levels in the group with lower exposure were tested after 1 yr. of exposure and were compared with a control group of non-exposed persons. The IgG levels were reduced in 85%, the IgM levels in 61% of the cases in the higher exposure group. The reduction reached the hypogammaglobulinemic levels in some miners and was followed by a propensity to infections of the respiratory tract. The IgA levels rose slightly in many cases. The dependence of the Ig levels on the rate of exposure was not absolute and showed great variations. (auth)

30105 HEALTH PHYSICS MEASURES TO IMPLEMENT NEW USAEC REGULATIONS RELATING TO RADIATION EXPOSURE OF THE GENERAL PUBLIC. Morgan, K. Z. (Oak Ridge National Lab., TN). pp 367-371 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Since health physicist first set levels for radioactive discharges of radioactive wastes into White Oak Lake at Oak Ridge National Laboratory in 1943, there has been a reduction by 36,000,000 between the level engineers urged to be set and the level being

recommended by the USAEC for similar discharges. It is indicated that these more conservative standards probably can be met but only by reliance on the most sensitive instruments presently available—such as the Ge(Li) detector systems that make possible energy resolution of at least 3 keV. Data must be collected from many carefully selected samples and use must be made of CUEX programs in following the critical radionuclides through the critical pathways of the critical segments to the critical segments of the population. (auth)

30106 EXPERIMENTS ON THE REDUCTION OF PRIMARY RADIATION EXPOSURE OF PATIENTS WITH CERVIX CARCINOMA. Michalica, W.; Kellner, G. (Univ., Vienna). Strahlentherapie; 145: No. 6, 652-655(1973). (In German).

Two groups of patients with carcinoma of the cervix were exposed to conventional radium and x ray therapy. One group of 31 women got no additional treatment, the other one was additionally treated with Elpimed, for the purpose of reducing the radiation exposure of the organism. In order to objectivate the effect of the drug, the values of iodine and bromine consumption in the serum were measured prior to radiotherapy and on the 6th and 42nd day. On the 6th day, the depression was nearly equal, on the 42nd day the difference was –18 μg/ml in the group with, –32 μg/ml in the group without additional therapy. The reaction to the exposure on the sixth day cannot be prevented, but on the 42nd day after the onset of radiotherapy a partial return to the initial state was found. (GE)

30107 IN VITRO METHODS OF ASSESSING LYMPHOCYTE TRANSFORMATION IN PATIENTS UNDERGOING RADIOTHERAPY FOR BRONCHOGENIC CANCER. Jenkins, V. K.; Olson, M. H.; Ellis, H. N. (Univ. of Texas, Galveston). Tex. State J. Med.; 31: No. 1, 19-28(Spr 1973).

Transformation of peripheral blood lymphocytes into immature blast cells was evaluated before, during, and after treatment with radiotherapy for patients with bronchogenic cancer. Samples of whole blood or of purified lymphocytes were cultured in the presence of the mitogen phytohemagglutinin (PHA) and the response assessed by measuring incorporation of tritiated thymidine (^{3}HTdR) into newly synthesized DNA. Data obtained by measurement of the isotope incorporated into whole blood cultures indicated that patients being treated by radiotherapy have a marked deficiency in their lymphocyte response greater than that due to the decreased number of lymphocytes alone. Assessment of the response by the more conventional method of culturing purified lymphocytes did not readily demonstrate the dramatic loss of responsiveness observed by the whole blood culture technique. The simplified, whole blood method offers considerable savings in time, cost, and volume of blood, permits testing a greater number of replicates for an individual blood sample, and allows more frequent sampling of a given patient. (auth)

30108 BLOOD STORAGE AND THE RATE OF CHROMOSOME ABERRATIONS AFTER IN VITRO EXPOSURE TO IONIZING RADIATIONS. Ivanov, B.; Leonard, A.; Deknudt, G. (CEN/SCK, Mol, Belg.). Radiat. Res.; 55: No. 3, 469-476(Sep 1973).

The influence of storage time and storage temperature on the yield of chromosomal aberrations after in vitro exposure of blood lymphocytes was investigated. Heparinized venous blood was stored at 5, 20, or 37°C for periods of 0, 24, 48, 173 hr and was then given 0, 125, 250, or 500 R of x irradiation. Immediately after exposure, the blood was cultured under standard conditions for 48 hr. Metaphases were examined for the presence of polycentrics, rings, minutes, chromatid exchanges, and breaks. Storage for 24 hr, particularly at higher temperatures, increases significantly the yield of aberrations. Storage at 5°C for 173 hr doubles the yield of radioinduced aberrations but has no influence on aberrations present in nonirradiated blood. (auth)

30109 OCCUPATIONAL RADIATION EXPOSURE RECORDS SYSTEMS. New York; American Standards Association, Inc. (1966). 14p. (ANSI-N13.6). American National Institute of Standards, New York.

This standard provides guidance to the employer for the systematic generation and retention of records relating to occupational radiation exposure. The principal objective of a complete and accurate radiation records system is the compilation of a comprehensive history of occupational exposure experience to aid in the protection of an individual and control of subsequent radiation exposure. The records should also enable the employer to: evaluate the effectiveness of the radiation protection program; demonstrate and facilitate compliance with contractual requirements and applicable governmental regulations; and reconstruct for legal or medical purposes, situations and conditions for analysis of the radiation dose received by individuals. (auth)

30110 RELATIONSHIP OF DNA REPAIR TO CARCINOGENESIS IN XERODERMA PIGMENTOSUM. Robbins, J. H.; Burk, P. G. (National Cancer Inst., Bethesda, MD). Cancer Res.; 33: 929-935(May 1973).

Radioautograms of intact ultraviolet (uv)-irradiated epidermis from a patient with xeroderma pigmentosum showed to detectable abnormality in uv-induced thymidine-^{3}H incorporation. This result is consistent with findings in this patient's uv-irradiated skin fibroblasts and lymphocytes and contrasts with findings in cells from typical xeroderma pigmentosum patients, all of which exhibit an impaired ability to repair uv-damaged DNA. The development of numerous tumors in the presence of apparently normal DNA repair suggests that some mechanism other than enhancement of uv carcinogenesis by defective DNA repair may be responsible for skin tumor formation in this patient and perhaps in all patients with xeroderma pigmentosum. (auth)

30111 RESULTS OF A SURVEY OF DIAGNOSTIC AND THERAPEUTIC X-RAY MACHINES, SUFFOLK COUNTY, NEW YORK, 1972. Becker, S. (Division of Environmental Health, Smithtown, NY). Radiat. Data Rep.; 14: No. 7, 397-400(Jul 1973).

An investigation was conducted in Suffolk County, N. Y., to determine the number of diagnostic and therapeutic x-ray machines that were in violation of the New York State Ionizing Radiation Regulation. An x-radiation inspection in 1962 had found that approximately 75 percent did not comply. The follow up survey in 1972 found that about 34 percent did not comply. This demonstrates that with careful supervision by a local health unit and cooperation by the professional practitioners, progress can be made to reduce the x-radiation exposure to the public. (auth)

30112 POTENTIAL EYE EXPOSURE TO PERSONNEL USING FLUOROSCOPIC TECHNIQUES. Maillie, H. D.; Gregory, W. D. (Univ. of Rochester, New York). Radiat. Data Rep.; 14: No. 8, 463-466.

Measurements were made on a mockup to estimate the weekly exposure to the eyes of personnel working in the vicinity of a fluoroscope used in diagnostic radiology. A radiologist utilizing the image intensifier and protected by means of a lead drape and panel could receive 36 mR/week to the eyes, whereas other individuals positioned away from this area, but in the vicinity of the table, could receive up to 700 mR/week. The factors associated with these estimates, and the importance of wearing personnel monitors where they will estimate eye exposures are discussed. (auth)

30113 WOUND HEALING AND RADIOTHERAPY WITH SPECIAL REGARD TO THE CARCINOMA OF MAMMARY GLANDS. Kuehne, J. Munich; Univ. Munich (1971). 53p. (In German). Thesis.

Nowadays, the most important therapy of carcinomas of mammary glands is operation with subsequent prophylactic irradiation of the scar tissue and the lymph tract. Due to the poor blood circulation in the scar tissue of the operated region, rather strong radioreactions may occur, as well as late effects in the form of atrophies, teleangiectasia, and indurations. Additional irradiation prior to operation may increase the number of cures. There is a certain amount of dispute as to the possible harmful effects of irradiation on wound healing but it has been found that these harmful effects will increase with increasing dose. Low doses might have a favorable effect on wound healing, however, high doses are required in cancer therapy. Another item of importance is the interval between irradiation and operation; if the operation is carried out during the phase of radiation sickness, delayed wound healing is to be expected. Should there be a strong exudative skin reaction due to pre-operation irradiation, special care must be taken in suturing not to overstretch the skin. It has not yet been definitely determined whether wound infections do in fact occur more frequently in pre-irradiated patients but it has been observed that wound infections, especially erysipelas, tend to become more severe in pre-irradiated patients. (GE)

30114 RADIATION RISK OF 5 REM IN 30 YEARS. Umsch. Wiss. Tech.; 73: No. 12, 378(1973). (In German).

There is not only a genetic risk due to ionizing radiation but also a risk of cancer induction. Therefore the additional radiation should not exceed 170 mrem/a. Especially the medical application of radiation should be lowered. (auth)

30115 RADIATION RISK DUE TO TECHNOLOGY. Umsch. Wiss. Tech.; 73: No. 16, 496-498(1973). (In German).

The highest part of the average radiation dose to the population results from natural radiation sources in spite of the increased application of radionuclides and ionizing radiation in industry, technology, and medicine. In modern industrial states the main source of the civilian radiation dose is the x-ray diagnostics. The radiation dose within buildings due to the natural radiation of the building materials is many times higher than that

in the direct environment of nuclear power plants. An estimation of the maximum tolerable radiation risk in relation to the natural occurrence of cancer is given. (GE)

30116 RADIATION EFFECTS IN BIOMEMBRANES. Wallach, D. F. H.; Weidekamm, E. (Tufts–New England Medical Center, Boston). Klin. Wochensch.; 51: No. 9, 419-430(1973). (In German).

The effects of ionizing radiation and the products of radiolysis on biological membranes, and in particular on plasma membranes, are reviewed. It derives from the increasing awareness that, in addition to DNA, biomembranes can be highly radiosensitive. General information concerning radiation dose is firstly summarized; secondly, the important radiochemical aspects of major membrane constituents–water, proteins, lipids, and carbohydrates–are discussed before reverting to the many observations of radiation effects on membrane morphology and function. Biomembranes were considered to be rather radioresistant until recently, when it was recognized that this is neither true for nuclear nor plasma membranes exposed to small amounts of proteases and/or phospholipases that are normally found in extracellular fluids as well as in intracellular organelles. Moreover, it has been clearly established that lymphoid cell plasma membranes are extremely radio-susceptible in terms of their transport mechanisms, a fact that could well account for the easy destruction of these cells, even in the interphase, as well as for the impairment of the immune response by radiotherapeutic maneuvers. The particular implications of these facts in tumor radiotherapy are presented in some detail. (auth)

30117 SCOPE OF ACTIVITIES AND ORGANIZATION OF THE CENTER FOR SAFETY ENGINEERING, RADIATION PROTECTION, AND NUCLEAR ENGINEERING OF THE LAND NORTH RHINE-WESTPHALIA. Arbeitsschutz (Cologne); No. 5, 234(1973). (In German).

30118 PATHOGENESIS OF INBORN AND RADIATION-INDUCED CATARACTS. Examination of 58 Families in Schleswig-Holstein and Hamburg. Timmermann, J. W. Kiel; Univ. Kiel (1971). 58p. (In German).

Thesis.

Investigations were conducted on families in order to determine the endogenous and exogenous factors promoting the development of inborn cataracts, to detect, if possible, genetic modes and to determine the frequency of irradiation-induced cataracts. One hundred cases were chosen as sample cases out of a file covering 1,100 patients with inborn cataracts or cataracts that were started during childhood. The investigation of 53 families did not yield sufficient information, whereas the analysis of the other 47 families showed a dominant-autosomal hereditary transmission of the disease with a total of 59 persons suffering from this disease. In the case of three families, a recessive-autosomal hereditary transmission could be assumed. In six other families, exogenous factors such as virus infections of the mothers during gravidity were found to have caused the formation of the cataract. In the remaining 27 families, there was only one person in each family suffering from a cataract. There were no signs of any effects of exogenous factors. An additional inquiry among radiologists, professional associations, and doctors at site, etc. another 11 patients were found whose disease could be clearly stated to be irradiation-induced cataract, on account of a given radiation exposure and the typical morphological findings. (GE)

30119 IRRADIATION OF THE FETUS. Kemp, F. H. (Nuffield Orthopaedic Centre, Oxford). Brit. Med. J.; 3: No. 5878, 497(1 Sep 1973).

The difficulties are pointed out concerning the implementation of the "Code of Practice for the Protection of Persons against Ionizing Radiations arising from Medical and Dental Use". It is suggested that it would help the medical profession to appreciate the long-term dangers of fetal irradiation and the risk of childhood cancer if the radiation risk were compared with risks inherent in other activities. The difficulties of evaluation of loss in monetary terms are also mentioned. (UK)

30120 RELATIONSHIP OF INTRAUTERINE RADIATION TO SUBSEQUENT MORTALITY AND DEVELOPMENT OF LEUKEMIA IN CHILDREN. A prospective Study. Diamond, E. L.; Schmerler, H.; Lilienfeld, A. M. (Johns Hopkins Univ., Baltimore). Amer. J. Epidemiol.; 97: No. 5, 283-313(May 1973).

Approximately 10,000 white and 10,000 black children who were exposed to intrauterine x rays from 1947 to 1959 in Baltimore were traced during 1961 to 1967 to determine their mortality experience. For comparison, about 19,000 white and 16,000 black children not exposed and matched by selected characteristics were traced in a similar manner; about 95% of both groups were successfully traced. The total mortality experience of the white exposed group during the first 10 yrs of life was almost twice that of the white control children, for all causes of death except malignant neoplasms (exclusive of leukemia), congenital malformations among males and diseases of the nervous system among females. The death rate from leukemia was about three times higher for the exposed than for the controls, a finding consistent with previous studies. In contrast, the mortality experience of the black exposed children was not greater than their controls. The absence of a difference in mortality from malignant neoplasms (exclusive of leukemia) in the exposed and control groups differs from several previous reports. The findings may be biased in that white mothers selected for prenatal x ray had characteristcs that predisposed to increased mortality in their offspring; this method of selection was not present among blacks. The possibility of a bias was analyzed by dividing the study groups into subgroups with characteristics that might have produced the observed mortality difference, including such characteristics as obstetrical factors and socioeconomic distribution. The socioeconomic adjustment did decrease the mortality differential from a 2-fold to approximately a 1.4- to 1.8-fold difference. The persistence of the mortality differential among whites suggests a real biological effect of radiation and its absence among blacks suggests differential susceptibility of the effect of radiation. (auth)

30121 EFFECTS OF INTRAVENOUS INJECTION OF CEPHARANTHIN ON BLOOD FORMATION DURING RADIOTHERAPY FOR MALIGNANT NEOPLASMS. Iida, K.; Segawa, H.; Awano, T.; Hosono, Y. (Kanazawa Univ., Japan). Rinsho Fujinka Sanka; 27: No. 3, 249-253(Mar 1973). (In Japanese).

Thirty-five patients in the Dept. of Gynecology of Fukui Prefectural Hospital, in which 23 cases with uterine cervic carcinoma, four cases with ovary cancer, six cases with body cancer and two cases with uterus sarcoma, were irradiated with telecobalt 300 γ radiation for 5 weeks. During radiotherapy, 50 mg of 20% kilit 20 ml Cepharanthin was daily injected intravenously to the patients. The value of leukocytes in 16 cases became more than that of pretreatment 5 weeks after chemotherapy with Cepharanthin, which was 45.7% of 35 cases. The value decreased within the rate of 20% was 22.8%, while the value decreased with the rate of more than 20% and the count below 3000 in number of leukocytes was 21.5%. The value of blood platelets increased more than that of pretreatment was 40%, while the value decreased within the rate of 20% was 20.3%. The blood platelet count decreased below 5×10^4 after treatment was 39.7%. The value of homoglobin increased more than that of pretreatment 5 weeks after chemotherapy was 47.5%, while the value decreased within the rate of 20% was 55%. Changes in values of GOT, GPT, and alkalinephosphatase examined by liver function test were in the range of normal value before and after treatment. No significant side effect was observed. (JA)

30122 USE OF PROTONS IN MEDICINE. HIGH ENERGY BEAMS FOR THERAPEUTIC AND DIAGNOSTIC PURPOSES INSTEAD OF X RAYS. Sandscheper, G. VDI (Ver. Deut. Ing.) Nachr.; 27: No. 10, 1-2(1973). (In German).

According to the experience of the Hammersmith Hospitals, London, frequent irradiation with small doses of high-energy neutron beams proved to be particularly effective. This induced the German Cancer Research Centre in Heidelberg to start an irradiation series using neutrons from the local compact cyclotron. It is being further considered to use protons instead of neutrons, as the irradiation effect of protons is density-dependent and thus more promising. The use of protons also opens up new possibilities in radiography. (GE)

30123 UROLOGICAL COMPLICATIONS AFTER GYNECOLOGICAL SURGERY AND RADIOTHERAPY. Hild, F. Wuerzburg, Ger.; Univ. Wuerzburg (1972). 89p. (In German).

Thesis.

On the basis of the relevant literature published within the last ten years and with reference to basic publications issued earlier, a review is given of this subject which touches both the field of gynecology and urology. The type and occurrence of urological complications after gynecological surgery and radiotherapy, the respective etiology and prophylaxis as well as the diagnostics and surgical therapy are discussed in detail. The cases examined by the author are 36 patients treated in the clinic on account of urological complications after gynecological surgery and radiotherapy within the period from Jan. 1, 1960 to Dec. 31, 1970. The details given in the literature with regard to etiology, prophylaxis, and therapy have been largely confirmed by own investigations. Of particular importance is the sometimes extremely long latency period of radioreactions that has been observed by the author and is also stated in many of the publications. In addition, radioreactions are characterized by a strong progression. In order not to jeopardize the success of gynecological surgery and radiotherapy and to be able to diagnose urological complications as early as possible and thus to prevent late effects, gynecological examinations must go hand in hand with regular urologic check-ups. (GE)

30124 CHEMICAL RADIOPROTECTION OF RADIOLOGISTS. Goyanes Villaescusa, V. (Juan Canalejo Hospital, La Coruna, Spain). Lancet; 2: No. 7828, 575-576(8 Sep 1973).

Lymphocyte metaphases of eight radiologists chronically exposed to x rays were analysed, and the frequency of chromosome abnormalities was calculated at four different times. After 48 hours' incubation (1st cell division), 100 cells by culture were classified. Three radiologists were treated with calf-thymus highly polymerized DNA (5 mg/kg/day) and ATP (0.5 mg/kg/day). Three unexposed controls (100 mitoses/culture) were simultaneously analyzed. The treated radiologists showed a 100% decrease in the rate of cells with structural chromosome aberrations. When treatment was suspended, the chromosome abnormalities rose again. Stable aberrations and aneuploid cellular clones were not modified by the treatment. (UK)

30125 RADIOLOGICAL IMPLICATIONS OF NUCLEAR POWER IN THE YEAR 2000. Nucl. Eng. Int.; 18: No. 208, 705-710(Sep 1973).

The study carried out by the USAEC of the radiation potentially to be received by the population of a representative area of the USA, the upper Mississippi River basin, in the year 2000, due to the operation of nuclear plants was reviewed. Extrapolated nuclear capacity predictions forecast 356,000 MW(e) of which 172,000 would be LMFBR, together with nine reprocessing plants. From these, 99% of the population would receive a potential total body radiation of less than 0.5 millirem per year. A few individuals would receive up to 1% of the natural background. The average figure was calculated to be 0.17 millirem. (auth)

30126 POSSIBILITIES OF CURATIVE TREATMENT OF THE SPINE WITH ULTRA-HARD X RAYS. Scheidel, A.; Nemeth, G.; Kuttig, H. (Univ., Heidelberg). Strahlentherapie; 146: No. 1, 36-42(1973). (In German).

A report is given on the methods of radical irradiation of the thoracic and lumbar part of the spine with ultra-hard x rays from the 42-MeV-betatron. The experimentally found isodoses are graphically visualized and are discussed. Out of the tested methods, the bisegmental pendulum irradiation with slight deflection of the bundle of useful rays leads to conditions of the dose distribution, which allow an irradiation of these parts of the spine with curative doses, taking greatest care of the spinal cord. (auth)

30127 BISEGMENTAL PENDULUM IRRADIATION OF THE AORTAL LYMPH NODES, UNDER DEVIATION OF THE USEFUL-BEAM BUNDLE, WITH ULTRAHARD X RAYS FROM THE 42-MeV-BETATRON. von Fournier, D.; Nemeth, G.; Kuttig, H. (Univ., Heidelberg). Strahlentherapie; 146: No. 1, 43-51(1973). (In German).

A method for cineroentgenotherapy with ultrahard x rays of the aortal lymph drainage is described. By bisegmental pendulum irradiation under contemporaneous deviation of the useful-beam bundle, a steep drop of the dose to the neighboring organs is reached. The dose distribution is compared to the methods of cobalt-60 teletherapy and is discussed. (auth)

30128 OMENTAL TRANSPOSITION IN THE TREATMENT OF RADIONECROSIS. Cort, D. F.; Collis, J. L. (Queen Elizabeth Hospital, Birmingham, Eng.). Brit. J. Surg.; 60: No. 7, 580-582 (Jul 1973).

A technique is described for the closure of chest-wall defects following radical excision for radionecrosis. Such defects are usually extensive with an avascular bed and often involve an opening into the pleural cavity; surgical closure poses significant problems. The method described here utilizes a transposed omental flap to provide a vascular bed for a skin-graft, while cephalad shifting of the origin of the diaphragm is used to close the pleural defect. This latter innovation has the dual advantages of simplicity and effectiveness, while greatly facilitating the passage of the omentum to the chest wall with minimal risk of omental strangulation. (auth)

30129 AUTORADIOGRAPHIC INVESTIGATIONS ON THE DOSE-EFFECT TIME-FACTOR IN RADIOTHERAPY. Contribution to the Radiobiology of the Small Intestine. Goebbeler, T. (Gesamthochschule, Essen). Strahlentherapie; 146: No. 1, 77-93(1973). (In German).

The relations of dose, effect, and time in radiotherapy are discussed. Autoradiographic measurements of the DNA-synthesis in the crypt-cells of the mouse duodenum after incorporation of ^{3}H-thymidin were the basis of this study. As the crypt-cells of the duodenum possess a high potency for DNA synthesis they are particularly suited for the investigation of radiation-induced inhibition of DNA synthesis, with regard to the relation between dose, effect, and time. The results after various doses and fractionation indicate that the DNA synthesis declines continuously after the end of irradiation, and reaches its minimum (that is 20 to 30% of the control value) after 6 hrs. Subsequently, the synthesis increases again and reaches its maximum after approximately 48 hrs, depending on the various dosage, fractionation, and temporal distribution of the doses. Under low dosage and high fractionation, this maximum exceeds the control values. Later, the synthesis stabilizes to the initial values. Hereby it is observed that the effect of a single dose is greater than a fractionation of the same single dose in several smaller doses, under the precondition that the temporal interval is sufficient. This means that it comes to recovery between the individual doses and that but one part of the previously applied dose yet is effective. To attain an adequate effect by fractionation, the total dose must therefore be augmented. If two doses are applied, which together are smaller than one big dose, the effect of these two small doses is significantly higher than the one of the big single dose, under the condition that the interval is short enough. This phenomenon can be explained by a certain synchronization of the cell populations due to the previous irradiation. Moreover, the second dose reaches a higher percentage of cells in a relatively radiosensible stage of the generation cycle. Finally, by measuring the filling-up doses, a direct relation between dose and time was ascertained, in relation to the same effect. From the resulting curve one can read off the second dose, according to various initial doses and certain time intervals. (auth)

30130 PANORAMIC DENTAL RADIOGRAPHY FOR MASS SCREENING. Bushong, S. C. (Baylor Univ., Houston, TX); Glaze, S. A.; Foster, J. K.; Copley, R. L.; Miller, J. T. Health Phys.; 25: No. 5, 489-494(Nov 1973).

Dental panoramic radiography has increased in popularity and use since its introduction in the late 1950's and proposals were made to apply this methodology as a mass screening tool. Ease of examination and the reportedly low radiation exposure to the anterior superficial tissues were cited as reasons for this application. However, in panoramic radiography the x-ray beam enters posteriorly which results in high doses to posterior and to internal tissues. LiF thermoluminescent dosimeters were employed to measure the radiation exposure to the superficial tissues of a Rando phantom and of patients during dental panoramic examination. Radiation exposures ranged from an average of 255 mR to the lateral tissues to 22 mR to the symphysis of mandible. Other anterior superficial tissues received exposures of 25 to 50 mR. On the basis of previous hazards analysis of radiographic procedures, these radiation exposures would seem to be excessive for application as a mass screening tool. (auth)

30131 LARGE FIELD IRRADIATIONS (MANTLE AND Y-FIELDS) WITH 42-MV PHOTONS IN LYMPHOGRANULOMATOSIS. Heuss, K.; Rado, M.; Hoeffken, W. (Allgemeine Ortskrankenkasse, Cologne). Strahlentherapie; 146: No. 1, 24-30(1973). (In German).

For the irradiation of large fields (such as mantle and Y fields in lymphogranulomatosis), 42 MV-photons of a betatron are used. The selection is made by pre-manufactured lead building stones that are easy to handle and can be put up on a movable carriage. Individual doses of 150 rad as a rule are well tolerated. The application of the required focal doses of 4000 rad is possible within 4 to 6 weeks. For the retroperitoneal lymph nodes, a homogeneous perradiation of the target volume is guaranteed, under optimal care of the skin. In the supradiaphragmal area a shifting of the dose maximum into the superficial groups of lymph nodes can easily be reached by putting some tissue-equivalent material before it. Overlapping the underdosage, which in general easily occur, are avoided here with certainty by single focussing of the total large field. (auth)

30132 THEORETICAL DETERMINATION OF OPTIMAL TREATMENT SCHEDULES FOR RADIATION THERAPY. Hethcote, H. W.; Waltman, P. (Univ. of Iowa, Iowa City). Radiat. Res.; 56: No. 1, 150-161(Oct 1973).

The reactions of a tumor cell population and a normal tissue cell population to irradiation are described by cell population kinetic models, which consider factors such as repair, reoxygenation, and repopulation. The optimal treatment schedule is a schedule of treatment doses and recovery times that eliminates the tumor and does the minimum damage to the normal tissue. The process of obtaining the optimal treatment schedule by dynamic programming is described. In the sample calculations, the surviving fraction of normal tissue cells using the optimal treatment schedule is greater by a factor of two than the largest surviving fraction of normal tissue cells using schedules with equal doses and equal recovery times. (auth)

30133 PANCYTOPENIA AND LEUKEMIA IN HODGKIN'S DISEASE: REPORT OF THREE CASES. Weiden, P. L.; Lerner, K. G.; Gerdes, A.; Heywood, J. D.; Fefer, A.; Thomas, E. D. (Univ. of Washington, Seattle). Blood; 42: No. 4, 571-577(Oct 1973).

Three patients with Hodgkin's disease who developed severe pancytopenia terminating in acute leukemia (two patients) or preleukemia (one patient) are presented. Prior treatment consisted of radiation therapy alone in two patients, and radiation plus chemotherapy in the third. The only patient in whom chromosomal analysis was performed showed an abnormal chromosome. Therapeutic radiation exposure is thought to contribute to the development of leukemia in such patients. Leukemia is an uncommon complication of Hodgkin's disease, but is being reported with increasing frequency. The rapid evolution of more aggressive modes of therapy makes it imperative that we seek more information regarding the incidence of this complication in order to achieve maximum therapeutic benefit for patients with Hodgkin's disease. (auth)

Vertebrates

Refer also to abstracts 29839, 30025, 30050, 30359, 30360, and 32152.

30134 (AD-733047) EFFECTIVE, READILY AVAILABLE TREATMENT FOR ACUTE RADIATION INJURY IN BEAGLES. Wise, D.; George, R. E. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Oct 1971. 19p. (AFRRI-SR-71-14). NTIS.

Generally available clinical methods were used to treat radiation injured beagles. Massive doses of antibiotics and other prophylactic measures were followed by treatment based on clinical judgment; effectiveness of the medical care was judged by the mortality response. The LD50/60 of beagles receiving treatment was 276 rads of mixed gamma-neutron radiation at 17 rads/minute; the LD50/60 for similarly irradiated beagles receiving no medical treatment was 218 rads. Survival time, symptomatic, hematologic, pathologic, and bacteriologic comparisons were also made. An additional group of irradiated beagles received similar medical care plus intravenously administered leukocyte and platelet concentrates; these dogs responded favorably to treatment following doses as high as 330 rads. (NTIS)

30135 (AD-762411) EFFECT OF A SUPRALETHAL DOSE OF RADIATION ON THE BLOOD–BRAIN BARRIER. Rene, A. A.; Parker, J. L.; Darden, J. H.; Eaton, N. A. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Feb 1973. 24p. (AFRRI-SR-73-2). NTIS.

Sprague-Dawley rats were subjected to a whole-body dose of 15 krads of mixed gamma-neutron radiation. Following irradiation, the animals were intravenously injected with horseradish peroxidase (HRP) and sacrificed. The medullae of these animals were fixed either by perfusion or by immersion, incubated in a substrate medium and processed for electron microscopic examination. In control animals subjected to the same procedures, the reaction product of the enzyme HRP and its substrate was confined to the lumina of the blood vessels in the brain fixed by immersion and completely washed out of the blood vessels of the brain fixed by perfusion. The brain tissue of the irradiated animals injected with HRP and fixed by immersion exhibited a dense reaction product in the lumina of the blood vessels, in invaginations of the luminal surface, and in micropinocytotic vesicles of the endothelial cell cytoplasm. The most significant alteration in the medullary tissue of the irradiated animals was an increase in the number of micropinocytotic vesicles in the endothelial cells. It appears, then, that damage caused by high doses of radiation initiates increased vascular permeability which may lead to the edematous condition observed in the irradiated animal. (GRA)

30136 (AD-854668) RADIATION RECOVERY STUDIES: RESPONSE STATISTICS. Technical Report, 1 June 1965–1 April 1969. Angleton, G. M. (Colorado State Univ., Fort Collins (USA). Collaborative Radiological Health Lab). May 1969. Contract AF29(601)-6782. 122p. (AFWL-TR-69-13). NTIS.

The immediate post-irradiation response patterns of leukocytes in beagles and sheep are described in terms of a fourth degree polynomial. The estimated times to first maximum deviation and the magnitude of the response at these times were analyzed with respect to the level of the irradiation exposure. A second phase of the study involves performing an LD-50 type of analysis of lethality data from sheep experiments. (auth)

30137 (CONF-710501-P2, pp 1042-1047) SPECIES DIFFERENCES IN SENSITIVITY OF MYOMORPH AND SCIUROMORPH RODENTS TO LIFE SHORTENING BY CHRONIC GAMMA IRRADIATION. Sacher, G. A.; Staffeldt, E. (Argonne National Lab., IL). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Several small rodent species are being given protracted gamma exposure daily for the duration of life beginning at young adult age. The daily dose levels are 12, 24, 32, 43, 56, 74, 97, and 125 R/day, plus controls. Thirteen species are being tested, but exposure schedules are not yet completed for some. Two species, Peromyscus californicus and Oryzomys palustris, are extremely radiosensitive at all levels from 12 to 125 R/day. Among species resistant to chronic irradiation are Tamias striatus, Rattus rattus, Peromyscus gossypinus, and Peromyscus leucopus. Between these extremes lie Sigmodon hispidus, Rattus natalensis, and Mus musculus. The rank correlations of survival times or mean accumulated doses (MADs) between dosage levels are not high, indicating that there are specific factors for sensitivity to different dose levels. As daily dose decreases, the range of MADs between species increases, from a factor of 3 at 125 R/day to a factor of 7 at 24 R/day. $LD_{50/30}$ for these same species has a two-fold range of variation, so sensitivity differences are amplified as the chronicity of exposure increases. Females of most species are more sensitive than males at dose levels from 24 to 125 R/day. This is true for $LD_{50/30}$ also. The four representatives of the family Muridae tested are at the upper end of the resistance range, and two hystricomorph species tested are both quite sensitive, but the eight species and subspecies of the family Cricetidae tested range from moderately resistant to extremely sensitive. It is not yet possible to perceive a pattern of taxonomic, ecological, or constitutional determination in these results. (auth)

30138 (CONF-710501-P2, pp 1048-1054) EFFECTS OF RADIATION ON REPRODUCTION OF IRRADIATED COTTON RATS (SIGMODON HISPIDUS) TRAPPED FROM ENCLOSED AREAS OF NATURAL HABITAT. Pelton, M. R. (Univ. of Tennessee, Knoxville); Provost, E. E. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Each month for four successive months four different groups of wild female cotton rats (eight females per group) were irradiated at dose levels ranging from 500 to 1200 R at a dose rate of about 20 R/min. These animals were released into 1-acre outdoor enclosures with four control females and four untreated males. Data from recaptured females revealed that breeding activity did not produce a lowered resistance to radiation. Susceptibility to radiation damage within the months encompassed by these experiments apparently did not change. A direct relationship between dose level and prevalence of pregnancy was shown. Sex ratios of progeny of irradiated females were essentially 50:50, and no gross abnormalities in the young were observed. Litter sizes decreased from controls to 750 R. Higher doses did not further decrease litter sizes thus lending credence to the idea that a pool of resistant oocytes remained shortly after irradiation and resulted in viable fetuses. The effects (maternal and genetic) of radiation on the females apparently resulted in a severe selection pressure acting on the animal before implantation of young (or shortly thereafter), since the number of placental scars equaled the number of young born. The dose level at which even immediate breeding is unsuccessful in the cotton rat under natural conditions was not adequately established by these experiments. (auth)

30139 (CONF-710501-P2, pp 1070-1075) INTRASPECIFIC COMPETITION AND RESPONSE OF PIKAS (OCHOTONA PRINCEPS) TO RADIATION. Markham, O. D.; Whicker, F. W. (Colorado State Univ., Fort Collins). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

This study was designed to demonstrate the effect of social interaction on the response of pikas (Ochotona princeps) to 500 R of ^{60}Co irradiation delivered acutely. Two 1-acre enclosures were stocked with 15 and 31 pikas, and another group of experimental animals was held captive in individual cages. One experiment was begun in August 1969 and another was conducted in October of the following year. Results indicated that animals confined individually had a significantly higher survival rate and longer survival time than animals free to interact in each of the two enclosures. These results substantiate findings of a previous experiment in which pikas studied in the natural environment at 4055 m elevation on Mount Evans, Colorado, had a lower $LD_{30(30)}$ and shorter survival times than individually caged animals in captivity. Animals in the 15-cage enclosure appeared to have a lower survival rate than animals in the 31-cage area. This difference may be explained by the greater number of dens and rock piles available per pika in the 31-cage area, which resulted from a greater number of deaths caused by territorial battles prior to the irradiation treatment. (auth)

30140 (CONF-710501-P2, pp 1076-1081) EFFECT OF ACUTE GAMMA IRRADIATION ON THE REPRODUCTION OF

PEROMYSCUS LEUCOPUS. DiGregorio, D.; Dunaway, P. B.; Cosgrove, G. E. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

To determine if a near LD50(30) dose of ionizing radiation will severely affect the reproduction of a wild rodent species, white-footed mice (Peromyscus leucopus) were irradiated with 950 rads and randomly mated with other irradiated or nonirradiated mice. Four groups were formed for the four possible combinations as follows: NM/NF—nonirradiated males and females; IM/NF—irradiated males, nonirradiated females; NM/IF—nonirradiated males, irradiated females; IM/IF—irradiated males and females. All pairs of group NM/NF produced young, while no group IM/IF pairs reproduced. Groups IM/NF and NM/IF were, respectively, 90.9% and 40.0% successful at producing young. Mean times from mating to first litter were 28.2, 87.7, and 86.5 days for groups NM/NF, IM/NF, and NM/IF respectively. Numbers of young per pair were 3.8, 3.1, and 0.8 for groups NM/NF, IM/NF, and NM/IF respectively. At this near LD50(30) dose, it appears that irradiated males and females can produce young within three months when mated with nonirradiated partners, but they cannot when mated together. At such a dose, a wild mouse population will be considerably reduced in numbers first by the direct killing effect and second by radiation-caused diminution of reproduction. (auth)

30141 (CONF-710501-P2, pp 1082-1086) SENSITIVITY OF THE RED-BACKED VOLE (CLETHRIONOMYS G. GAPPERI) TO ACUTE GAMMA RADIATION. Buech, R. R. (Forest Experiment Station, Rhinelander, WI). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The radiosensitivity of wild-caught red-backed voles, Clethrionomys g. gapperi, to acute, whole-body ^{137}Cs gamma radiation was studied under laboratory conditions. Probit transformation of mortality data indicated that the $LD_{50/30}$ for both sexes combined was 1197 R (1154 to 1240 R). Mean survival time for 30-day decedents ranged from 4.6 days at 1530 R to 16 days at 1092 R. Mean weight for survivors at 30 days was essentially unchanged at all treatment levels. For decedents, weight loss at death was related to survival time irrespective of dose level. Autopsy revealed that the weight of the gastrointestinal tract accounted for a large portion of the observed weight losses. Secondary effects observed were: conjunctivitis, ataxia, passiveness, epilation, graying of hair, and a high incidence of lens opacities for those retained for duration of life. (auth)

30142 (CONF-710501-P2, pp 1100-1105) RADIATION EFFECTS ON SERUM PROTEINS, HEMATOCRITS, ELECTROPHORETIC PATTERNS, AND PROTEIN COMPONENTS IN THE BLUEGILL (LEPOMIS MACROCHIRUS). Ulrikson, G. U. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Gel electrophoresis was used in conjunction with a spectrometric protein analysis to study the effects of radiation on the concentration of serum protein fractions in bluegill (Lepomis macrochirus). Four groups of 40 bluegills each were acclimated in aquaria at 20°C for 30 days. Three groups were then exposed to 1000, 2000, and 3000 R, respectively, at 167 R/min. Blood samples were taken from each test group at intervals of 2 and 24 hr and then every 48 hr thereafter. A severe decrease (~50%) occurred in the beta globulins, alpha globulins, and albumins within 2 to 24 hr after exposure. After the initial decrease, hemoconcentration occurred. (auth)

30143 (CONF-710501-P2, pp 1106-1112) SENSITIVITY OF CARP (CYPRINUS CARPIO) EMBRYOS TO ACUTE GAMMA RADIATION. Frank, M. L. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium in radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Cyprinus carpio Linnaeus eggs were exposed to acute gamma radiation (500 to 16,000 rads) at different stages of development to observe the effects of radiation on development and hatchability. Except for an increase in radiosensitivity during late cleavage, radiosensitivity decreased as development increased; however, the rate of change was not constant throughout development. Stages in order of decreasing radiosensitivity were: zygote, late cleavage, and post-organogenesis. Differences in radiosensitivity were related to the physiological state of cells at the time of irradiation. During early cleavage when cell division was synchronous, radiosensitivity was probably influenced by the stage of mitosis at the time of irradiation. Hatchability of eggs irradiated after organogenesis was not affected by any of the experimental doses. The typical development of carp eggs from the zygote to larval stage is shown in a series of photomicrographs. (auth)

30144 (CONF-710501-P2, pp 1119-1124) EFFECTS OF CHRONIC GAMMA IRRADIATION ON THE FISH, ORYZIAS LATIPES. Kaufman, G. A.; Beyers, R. J. (Univ. of Georgia, Athens). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Two strains (Rice and Ozark) of Japanese medaka, Oryzias latipes, were used to examine the effect of radiation stress on body composition. Two male and three female fish were placed in each of 40 cylindrical glass aquaria (diameter, 38 cm; depth, 43 cm). Two aquaria with Ozark strain and two with Rice strain were placed at various distances from a 9200-Ci ^{137}Cs source. The experiment was conducted for 79 days. The dose received by the medaka ranged from 220 to 16,500 rads. Wet weight and standard length were recorded before and after irradiation. Fat was extracted from all adult fish at the end of the study. There was not a significant difference in the survival of the two strains; however, the females were more sensitive to radiation stress than the males in the Ozark strain. The number of surviving medaka was inversely correlated with dose in the Ozark strain. There was not a significant difference in the relationship of wet weight to standard length before and after irradiation in either Ozark or Rice strain. However, the percent of water in the medaka decreased as dose increased. No significant differences in the percent lean dry biomass (dry weight basis) were found between strains or dose levels. (auth)

30145 (CONF-710501-P2, pp 1131-1143) RADIATION-INDUCED STERILITY IN NATURAL POPULATIONS OF LIZARDS (CROTAPHYTUS WISLIZENII AND CNEMIDOPHORUS TIGRIS). Turner, F. B.; Licht, P.; Thrasher, J. D.; Medica, P. A.; Lannom, J. R. Jr. (Univ. of California, Los Angeles). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Leopard lizards (Crotaphytus wislizenii) and whip-tail lizards (Cnemidophorus tigris) have been exposed to gamma radiation in a fenced 20-acre area since January 1964. Free-air exposure rates over most of the area were around 4 to 6 R/day. Average annual tissue doses were estimated with implanted lithium fluoride microdosimeters at 400 to 500 rads/year for Crotaphytus and about half this for Cnemidophorus. Demographic data and failure of mature female Crotaphytus in the irradiated area to assume typical reproductive coloration indicated absence of reproduction by this species in 1967 and 1968. Three female leopard lizards taken from the irradiated plot in May and June 1969 exhibited complete regression of ovaries, undeveloped oviducal walls, and hypertrophied fat bodies. One of three irradiated males collected at the same time was sterile. All of 20 control individuals taken in 1969 exhibited ovaries, oviducts, testes, and epididymides normal for the season. The first sterile female Cnemidophorus was collected in June 1969. Of four more females taken from the irradiated area in June 1970, three lacked ovaries; one had ovaries and had recently laid eggs. Three males from the irradiated area in 1970 did not differ in sexual condition from three control males. Experimental administration of follicle-stimulating hormone to the three apparently sterile Cnemidophorus females collected in 1970 had no effect on oviducal growth. The sterility observed in both species is attributed to long-term exposure to gamma radiation. Reproduction by another lizard, Uta stansburiana, occupying the irradiated area was apparently normal from the beginning of the experiment. The difference in response of Uta and the other two species is attributed to their markedly different life-spans and demographic regimes. (auth)

30146 (COO-1201-32) EFFECTS OF RADIATION ON THE DEVELOPING MAMMALIAN NERVOUS SYSTEM AND BEHAVIOR. Final Report. Hicks, S. P. (Michigan Univ., Ann Arbor. Dept. of Pathology). Aug 1973. Contract AT(11-1)-1201. 27p. Dep. NTIS $3.50.

Results are summarized from studies on the effects of prenatal or neonatal exposure of rat brain to various doses of x radiation, ranging from 200 to 600 rads, on nervous system development and behavioral adaptation to brain injury. Extensive cytological studies of the cerebral cortex at various times during development were carried out. The degree of impaired nervous system function was also correlated with the degree of radioinduced malformation observed following exposure of the visual cortex, cerebellum, or retina at various developmental stages. A remarkable ability to adapt behavioral patterns to compensate for injuries to the nervous system was demonstrated. (24 references.) (CH)

30147 (FRNC-R-19) SCIENTIFIC WORK, 1971. (Centre de Recherches du Service de Sante des Armees, Paris (France). Division de Radiobiologie). 1971. 356p. (In French).

One hundred and eight papers are included on biological stresses, diagnosis and therapy, general biology, microbiology, radiopharmacology, advanced pharmacology, hemiobiology, ergonomy, psychology, and technology. 33 papers were separately abstracted for NSA. (FR)

For abstracts of individual papers see: 29632, 29667, 29668, 29929, 30007, 30076, 30148–30167, 30247, and 30334–30339.

30148 (FRNC-R-19, pp 10) EFFECT OF NONLETHAL WHOLE BODY GAMMA IRRADIATION ON SPONTANEOUS AND EVOKED CEREBRAL ELECTRICAL ACTIVITY OF ADULT RABBITS. Court, L.; Brouillet, B.; Dufour, R. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The effect of whole-body γ irradiation on the spontaneous and evoked cerebral electrical activity of adult rabbits was studied for doses of 650, 450, and 250 rads. Changes in the electrical cerebral excitability were observed for doses of 250 rads. These changes indicate that arousal thresholds are modified after irradiation, the influx originating from the immediate periphery. (FR)

30149 (FRNC-R-19, pp 11-16) MODIFICATIONS IN SPONTANEOUS AND EVOKED CEREBRAL ACTIVITY OF THE HYPOTHALAMUS. Changes in the Autonomic Nervous System. Lasmoles, F.; Court, L.; Dufour, R. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The radiosensitivity of the hypothalamus was studied for the case of rabbits subjected to a total exposure of 650 and 250 rads. In this way, the effect of radiation on the electrical activity of the hypothalamus, the changes occurring in the evoked visual potentials, the variations in the central temperature, and alterations in the heart beat rate were studied. It was concluded that the modifications observed are not more significant than those found in the cortex or archeo-cortex. (FR)

30150 (FRNC-R-19, pp 18-19) EFFECTS OF GAMMA IRRADIATION ON THE ELECTRICAL ACTIVITY OF THE RETINA. Basin, M.; Court, L.; Velly, M. R. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Irradiation of rabbits with sublethal whole-body doses led to electroretinogram alterations. These alterations were paradoxically more distinct at 650 rads than at 850 rads. The alteration consisting of a diminution in the amplitudes of the a and b2 waves and a transient dispersion of the e waves. At 850 rads, the dispersion of the results render any conclusion about them impossible. This phenomenon was also encountered in the modifications occurring in the electrical cerebral activity when lethal doses are considered. (FR)

30151 (FRNC-R-19, pp 20-23) SYNTHESIS OF COLLAGEN IN FRACTURES IN IRRADIATED MICE. Drouet, J.; Retbi, J.; Nguyen, T. L. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Irradiation of mice with x rays resulted in a deficiency in the collagen synthesis near the fracture. A deficiency of 37% was observed 18 days after an experimental fracture made 2 to 5 minutes prior to exposure to ionizing radiation. (FR)

30152 (FRNC-R-19, pp 24-27) ALKALINE PHOSPHATASES IN MICE SUFFERING FROM A FRACTURE AND IRRADIATED. Drouet, J.; Goyffon, M.; Legrand, A.; Brunet, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Until the 15th day following irradiation, mice suffering from a bone fracture and subsequently irradiated, exhibited an alkaline phosphatase activity that was only very slightly different to that due to irradiation only. After the 15th day, the activity of this biological parameter became similar to that observed for mice having suffered fractures, but not irradiated. It is after an average delay period that the most significant variations were observed. (FR)

30153 (FRNC-R-19, pp 35-40) STUDY OF THE CHANGES OCCURRING IN FRACTURES IN IRRADIATED MICE USING FLUORESCENT TRACERS. Deloince, R.; Drouet, J.; Castanet, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Mice having suffered a fracture of the tibia and fibula were given whole-body irradiations of 810 and 820 R, 2 and 5 minutes after the fracture. The repair process was delayed as a result of the following modifications: increase in inflammation phenomena; slow down or stopping of the production of bone cells; appearance of only slightly vascularized tissue containing cartilaginous and distrophic bone islets; formation of bone tissue with thick and irregularly spaced trabeculae. (FR)

30154 (FRNC-R-19, pp 40-45) EFFECT OF THREE TYPES OF LESIONS ON THE MORTALITY OF MICE EXPOSED TO IRRADIATION. Drouet, J.; Nguyen, T. L.; Fatome, M.; Sauvant, D. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The mortality of mice exposed to x or γ radiation and subjected to a further lesion was studied. In this way it was discovered that the addition of a fracture, a burn, or a skin wound did not change the prognosis of the effect due to the irradiation. It seems possible that a burn can sometimes reduce the mortality. The results demonstrated the importance of the associated traumatism and of the time interval between the lesion and the irradiation. (FR)

30155 (FRNC-R-19, pp 152-154) EFFECT OF CEPHALIC IRRADIATION ON THE HUMORAL IMMUNITARITY RESPONSE OF THE ADULT RABBIT. Servan, P.; Darnil, A.; Hacquin, A. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Irradiation of the heads of adult rabbits with very high doses (1800 rads) resulted in a modification in the response of the circulating antibody produced as a consequence of an injection of human albumin serum performed 24 hours after irradiation. In these rabbits a sharp increase in the number of antibodies occurred after an immunodepression period, and at the 21st day, the level reached was comparable with that observed in nonirradiated rabbits or in rabbits having had only their legs irradiated, the latter animals presenting a very sharp increase. Although it is not possible to specify the cause of the immunodepression in the case of irradiated animals, it does not appear that this increase in the humoral response latent period can be uniquely explained in terms of lymphopenia, and it seems likely that a diencephalic action should be taken into account. (FR)

30156 (FRNC-R-19, pp 163-164) SYSTEMATIC SELECTION AND A MORE DETAILED SELECTION OF RADIOPROTECTING SUBSTANCES. Results Obtained in 1971. Fatome, M. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The selection of radioprotective substances enables the radioprotecting properties of chemical substances chosen for their pharmacological properties or chemical structures to be determined. Two selection procedures were used: a systematic selection and a more detailed selection. Both procedures are based on the survival for 30 days of mice x-irradiated with a 100% lethal dose. In 1971, 21 out of 186 products tested were sufficiently interesting to be considered for more detailed selection. Seven of these products belong to a chemical family having unknown radioprotecting properties. A special product, methyl 2-(2-aminoethyl)-thioglycolate chlorhydrate C 511, which results from the condensation reaction between glyoxylic acid and cysteamine, presents radioprotective properties comparable to those of the best classical radioprotecting substances. (FR)

30157 (FRNC-R-19, pp 165-166) SELECTION OF A NEW RADIOPROTECTING SUBSTANCE. Frossard, H.; Fatome, M.; Perles, R. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Detailed selection verified and quantified the results of systematic selection. It established the existence of a new radioprotecting substance, methyl 2-(2-aminoethyl)-thioglycolate chlorohydrate, C 511, which results from the condensation reaction between glyoxylic acid and cysteamine. In relation to classical radioprotecting substances, such as serotonine and cysteamine, this substance produces equal or superior results in mice and is only slightly toxic. Its utilization in human therapy is envisaged in the near future. (FR)

30158 (FRNC-R-19, pp 168) PRELIMINARY STUDIES OF THE ACTION OF WR 2721 ON THE CEREBRAL ELECTRICAL ACTIVITY OF ADULT RABBITS. Effect on Irradiated Animals. Fatome, M.; Meilleurat, M.; Court, L. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The product WR 2721 (a substituted aminoethyl phosphorotioic acid) was found to be an efficient radioprotecting substance for mice and dogs. In addition this product has a very low toxicity. Rabbits were exposed to a γ irradiation dose of 650 rads, 500 mg/kg of radioprotecting substance being used. The irradiation did not lead to the electrical charges in the brain normally encountered with such a dose. An increase in the slow activities occurred and the plot became normal three hours after injection. Energy studies confirmed that the product tends to reduce the energy increases

observed during the irradiation, to oppose transfers in the low frequencies of the energy content of the signal, and to favor certain cerebral intercorrelations. (FR)

30159 (FRNC-R-19, pp 169) EFFECT OF SEROTONINE ON THE SPONTANEOUS AND EVOKED CEREBRAL ELECTRICAL ACTIVITY OF THE NORMAL AND WHOLE-BODY IRRADIATED ADULT RABBIT. Fatome, M.; Court, L.; Meilleurat, M. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Investigations were made of the electrophysiological modifications induced by irradiation in rabbits to which the radioprotecting substance serotonin (5-hydroxytryptamine) had been administered. The effects of intravenously administered doses of between 1 and 12mg of serotonin/kg were studied. It appears that serotonin has the opposite effect to that caused in normal subjects by whole-body irradiation. Animals were exposed to a 650 rad dose after having been intravenously injected with 10mg of serotonin/kg. (FR)

30160 (FRNC-R-19, pp 170-173) EFFECT OF WHOLE-BODY IRRADIATION ON THE URINARY ELIMINATION OF MONOAMINES AND THEIR PRINCIPAL METABOLITES (VANILMANDELIC AND 5 HYDROXYINDOLE ACETIC ACIDS) IN THE RAT. Maigrot, J. C.; Riotte, M.; Blanc, T.; Vignal, A. (Centre de Recherches du Service de Sante des Armees, Lyon). 1971. (In French).

Whole-body gamma irradiation of the rat with doses ranging from 800 to 1000 rads increases the elimination of biogenic amines and their principal metabolites such as vanilmandelic acid and 5 hydroxyindole acetic acid in the days following the irradiation. This latter substance is a metabolite of serotonin. The elimination of adrenaline is not modified but the elimination of dopamine is reduced. A return to the normal values is observed after the 8th or 10th day, this return is followed by an increase to very high values, which is maintained until the death of the animal. (FR)

30161 (FRNC-R-19, pp 173-174) EFFECTS OF TOTAL IRRADIATION ON THE ACTIVITY OF HEPATIC TRYPTOPHAN PYRROLASE AND THE LEVEL OF PLASMATIC TRYPTOPHAN IN THE RAT. Morelis, P.; Grafmeyer, D.; Riotte, M. (Centre de Recherches du Service de Sante des Armees, Lyon). 1971. (In French).

A total exposure to 900 R increased the hepatic pyrrolase tryptophan activity from the first quarter of an hour after exposure. The activity increased regularly during the four days of observation. This increase was very significant and calculations of the regression polynomials confirmed the predominant linear trend of the variation. The effects on the total plasmatic tryptophan level were also studied: a small reduction in the level occurred during the fourth hour, an increase was then observed, a maximum being reached 48 hours after the irradiation; a further drop in the level was subsequently observed but the level attained remained higher than that of the reference animals. The variation was significant in variance analysis calculations. (FR)

30162 (FRNC-R-19, pp 175-177) CHANGES IN THE PLASMATIC CORTICOSTEROID LEVEL AFTER GAMMA IRRADIATION. Breuil, L.; Valette, L.; Guerin, B. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The plasmatic corticosteroid level in rats subjected to a total exposure of 750 rads presents two important peaks: the first occurring during the third hour following the irradiation, the level re-establishing itself to its normal value after five days; the second occurring at the ninth day. It was not possible to study the behavior of rats individually because of the large blood samples required to measure the corticosteroid level. Experiments are nevertheless underway on rabbits, animals having a larger quantity of blood than rats. In this way it will be possible to establish a correlation between the renal reaction and changes leading to survival or death. (FR)

30163 (FRNC-R-19, pp 177-180) PLASMIC TRANSAMINASES AFTER THE GAMMA IRRADIATION OF RATS. Breuil, L.; Tellier, P. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Rats were irradiated with 100, 200, 300, 400, 500, 600, 750, and 1000 rad doses. The transaminases were measured two hours after irradiation for a group of rats irradiated with 750 rads, and six hours after irradiation for the remaining groups. Oxaloacetic glutamic transaminase measurements have a prognostic value and allowed the animals to be divided into three groups: a group in which survival is certain, a group in which death is imminent, and a further group in which the outcome is uncertain. In this last group, measurements of the oxaloacetic glutamic transaminase after 10 and 12 hours were used to distinguish the animals that would survive from those that would die. In order to determine whether these experiments are applicable to other species, transaminase measurement experiments were initiated on rabbits. (FR)

30164 (FRNC-R-19, pp 180-182) EFFECT OF IRRADIATION ON THE VALINE, LEUCINE, AND ISOLEUCINE CONTENT OF RAT PLASMA. Valle, C.; Lewinski, C.; Sicard, M. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Study of the changes occurring in the aminated plasmatic acids of rats after irradiation with 750, 600, 550, and 450 rads were studied. An increase in the concentrations of the following three amino acids was observed: valine, isoleucine, leucine. The higher the absorbed dose, the slower is the return of the enhanced concentration to its normal value. The plasmatic enhancement of the three amino acids studied appears to be a biochemical consequence of the irradiation although nothing can be confirmed at the present state of experimentation except for the time for the return to normal. (FR)

30165 (FRNC-R-19, pp 183-184) EFFECT OF A SEMI-LETHAL WHOLE-BODY DOSE OF GAMMA IRRADIATION IN A HYPERGLYCEMIC TEST CARRIED OUT INTRAVENOUSLY ON RABBITS. Sentenac Roumanou, H.; Vannier, G.; Bourguignon, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Twenty four hours after rabbits were given semi-lethal 450-rad whole-body doses of gamma irradiation, the reduction in the glucose assimilation coefficient reached its maximum value. The return of this coefficient to its normal value occurred between the third and fourth day following irradiation. When only the head or body of the rabbit was given the same dose, the drop in the value of this coefficient was less marked and not very reproducible. In the case of whole-body irradiation, the threshold dose associated with a drop in this coefficient is about 200 rads. Biological dosimetry is difficult because in excess of this dose, the drop in the value of the coefficient appears to be independent of the dose. (FR)

30166 (FRNC-R-19, pp 202-204) EFFECT OF THYROID HORMONES AND IRRADIATION ON THE ADENYLCYCLASE OF PLASMIC MEMBRANES OF THE RAT LIVER. Marc, J. C.; Junien, J. L.; Rocquet, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The activity of the adenylcyclase of the hepatic cellular membrane of the rat in the presence of adrenaline and iodothyronines during γ irradiation was studied. Simultaneous investigations were made of the behavior of 5′-nucleotidase (specific labeling substance for plasmic membranes). The two enzymes behave very differently: 5′-nucleotidase is resistant to radiation of the order of 100,000 rads, while adenylcyclase is very much more sensitive. In addition, this sensitivity depends on whether NaF or glucagon is used for the stimulation. Gamma irradiation enables the dose differences required to destroy certain enzymes to be determined and an adrenaline-effect to be obtained entirely in vivo. (FR)

30167 (FRNC-R-19, pp 325-327) DEVELOPMENT OF A TECHNIQUE FOR ASSAYING CYCLIC AMP IN URINE IN VIEW OF ASSAYS WITH IRRADIATED ANIMALS. Breuil, L.; Lavelle, B.; Soyer, P. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The assay is performed in four stages: cyclic AMP is transformed into AMP by a phosphodiesterase; AMP is transformed into ATP; in the presence of this ATP and a hexokinase, some of the glucose is phosphorylated into glucose 6 phosphate; this substance is then oxidized in the presence of glucose 6 phosphate dehydrogenase and NaDP. Measurements are then made of the changes in optical density. The sensitivity of this technique is theoretically 10^{-9}M/ml (in mole per ml). The preliminary results obtained after irradiation are encouraging and suggest that experiments should be performed in which rats are irradiated with various doses of irradiation and their urines assayed in order to study the correlation between survival and death. (FR)

30168 (TID-26449) TRANSPLANTATION OF PANCREATIC ISLETS: FUNCTIONAL REMISSION OF EXPERIMENTAL DIABETES MELLITUS IN MICE. Kramp, R. C. (Tennessee Univ., Knoxville). Aug 1973. 103p. Dep. NTIS $7.25.

Thesis.

Groups of mice were made diabetic with alloxan or streptozotocin and they received subcutaneous transplants of pancreases, which had been ligated 6 to 8 weeks earlier, from isogeneic donors. Five weeks later blood glucose levels were substantially lower in grafted than in nongrafted mice. Complete remission of hyperglycemia was observed only in grafted mice. When islets in ligated pancreases were destroyed in vivo by pretreatment of donors with streptozotocin or alloxan, remission of hyperglycemia did not occur in diabetic recipients. Studies with hybrid mice showed that isografts but not allografts succeeded in

reducing blood glucose in diabetic recipients. In isogeneic radiation chimeras that had been x-irradiated and given isogeneic bone marrow therapy 20 weeks earlier, isografts but not allografts of pancreatic tissue succeeded in reducing blood glucose of diabetic recipients. On the other hand, allogeneic radiation chimeras accepted pancreatic grafts from the host type or from the same hybrid that served earlier as a source of bone marrow. (HLW)

30169 COMPARATIVE EFFECTS OF EXPOSURE OF THE MOUSE TO RADIATION AT CONSTANT AND CHANGING DOSE RATES. Spalding, J. F.; Archuleta, R. F.; Johnson, O. S.; London, J. E. (Los Alamos Scientific Lab., NM). Health Phys.; 25: No. 4, 381-385(Oct 1973).

Two sublines of strain RFM mice with different radiation-resistance characteristics were exposed to equivalent, repeated, 46.4-hr continuous γ treatments, some groups at a changing dose rate and others at a fixed dose rate. Three dose-rate levels between approximate means of 2 to 5 rads/hr were studied. Changing dose rates were more biologically damaging than were equivalent, constant dose rates. There were differences in substrain radiation resistance to all exposure conditions. (auth)

30170 INFLUENCE OF RADIATION AND CYCLOPHOSPHAMIDE ON TUMOR UPTAKE OF $^{203}HgCl_2$ UNDER EXPERIMENTAL CONDITIONS. Emrich, D.; Willgeroth, F.; Bargon, G.; Eger, W. (Univ., Goettingen, Ger.). Int. J. Nucl. Med. Biol.; 1: No. 1, 23-27(Jan 1973).

The effect of a single dose of external x-radiation (range 250 to 2000 rads) and a single dose of cyclophosphamide (0.6 mg/100 g body weight) 2 to 6 days after its administration was studied for the uptake of $^{203}HgCl_2$ by the transplantable Yoshida sarcoma in the rat. In order to evaluate the influence of the two forms of treatment, the size of the tumor was measured and histologic examinations were performed. After radiation there was a dose-dependent decrease of the tumor uptake of $^{203}HgCl_2$ and after the antineoplastic drug a time-dependent decrease. In both instances the decline of the $^{203}HgCl_2$ tumor uptake parallelled the increasing influence of the two forms of treatment on the tumor in relation to its growth and its histologic pattern. (auth)

30171 ALKALINE PHOSPHATASE SERUM IN RADIO-ASSOCIATED LESIONS OF MICE. Drouet, J.; Legrand, A.; Bruet, G.; Goyffon, M. (CRS, Clamart, France). Compt. Rend. Soc. Biol.; 166: No. 10, 1270-1273(1972). (In French).

Alkaline phosphatase occurring with lesions associating a diaphyseal fracture with a whole-body exposure to 810 R of x rays was studied. The intermediate variations observed are different to those observed simply after a fracture or after irradiation; the phenomenon is less perturbed with the radioassociated lesions than after a simple irradiation. (FR)

30172 INFLUENCE OF THYMUS CELLS IN HEMOPOIESIS: STIMULATION OF HEMOPOIETIC STEM CELLS IN A SYNGENEIC, IN VIVO, SITUATION. Lord, B. I.; Schofield, R. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Blood; 42: No. 3, 395-404(Sep 1973).

Using the spleen colony-forming technique to assay hemopoietic stem cells, (CFUs) experiments have been carried out to investigate the role of thymus cells in hemopoiesis. The experiments were carried out by injecting live or killed thymus cells into lethally irradiated mice together with hemopoietic tissue containing CFUs. The effect of thymus cells on endogenous colony formation in sublethally irradiated mice was also investigated. Colony formation by normal bone marrow or spleen is unaffected by the addition of thymus cells, but cell populations damaged by radiation all demonstrate increased colony numbers when live thymus cells are injected within 48 hr of initiating colony formation. Endogenous colony formation resulting from an x-ray dose of 475 rad is increased 2.9 times: exogenous colony formation from bone marrow or spleen populations whose CFUs content has been reduced to approximately 20% of normal with 180-rad γ-rays is increased 2.1 times. Studies investigating this enhancement demonstrate that at least some of the colony-forming cells require the cooperation of live thymus cells. Under the conditions of these experiments, at least 10^6 thymus cells must be injected to produce maximum enhancement. (auth)

30173 IN VIVO AND IN VITRO EFFECTS OF X-IRRADIATION AND HISTAMINE-PO_4 ON RAT AND BOVINE PINEAL HIOMT ACTIVITY AND MELATONIN SYNTHESIS. Ellis, L. C.; Jaussi, A. W.; Tait, G. R.; Urry, R. L. (Utah State Univ., Logan). Life Sci.; 13: No. 7, 835-845(1 Oct 1973).

Localized irradiation to the heads of adult male rats with 450 R increased pineal gland hydroxyindole-o-methyl transferase activity while the same amount of irradiation restricted to the body diminished the activity of the enzyme. Anesthesia had no effect on this enzyme. Extremely high doses of irradiation were required (3,870 R) to inhibit HIOMT activity of bovine enzyme preparations in vitro. Localized irradiation of the head of rats with 450 R increased melatonin biosynthesis from tryptophan-3-^{14}C, but irradiation of the body only had no such an effect. Injections of histamine-PO_4 into rats or the addition of it to the incubation media of bovine enzyme preparations inhibited melatonin synthesis and bovine HIOMT activity, respectively. (auth)

30174 RENAL FAILURE IN PERINATALLY IRRADIATED BEAGLES. Phemister, R. D.; Thomassen, R. W.; Norrdin, R. W.; Jaenke, R. S. (Colorado State Univ., Fort Collins). Radiat. Res.; 55: No. 3, 399-410(Sep 1973).

Of 99 beagles receiving 270 to 435 R ^{60}Co gamma radiation (bilateral, whole-body; 10 min exposure time) at 55 days in utero or 2 days of age and allowed to survive beyond 70 days, 15 have subsequently died in chronic renal failure at times ranging from 8.5 to 24 mo of age. The current incidence of renal failure approximates 25% in males but only 2% in females. These results, which emphasize perinatal renal radiosensitivity in the dog, have important implications for man. (auth)

30175 VETERINARNAYA RADIOLOGIYA. (Veterinary Radiology). Vokken, G. G. Leningrad; Kolos (1973). 240p.

Chapters are included on basic nuclear physics; dosimetry and radiometry; biological effects of ionizing radiation and its manifestations in agricultural animals; toxicity of radioactive substances; radioecological bases of radiochemical and radiometric examination of substances of veterinary interest; use of radionuclides and nuclear radiation in agricultural science and practice; bases of radiation safety; and veterinary radiological laboratories. (433 references) (MG)

30176 pH AND RADIOPROTECTIVE EFFECT OF CYSTEAMINE ON THE SKIN. van Caneghem, P.; Beaumariage, M. L. (Univ., Liege). Strahlentherapie; 145: No. 6, 663-673(1973). (In German).

Young black mice, aged 8 days, were irradiated with 300 R of x rays. At this dose, a strong dysplasia and a good protective effect of cystamine was observed. The animals received an i.p. injection of the substances to be tested 10 min before irradiation. Three days later hair samples were taken and the percentage of dysplastic hair was determined. Besides this, the pH of the blood, the skin temperature and the oxygen pressure of the skin were determined. Cysteamine does not protect the hair coat against the dysplastic effect of x rays, whatever the pH of the solution, but on oxidation to the disulfide, the radioprotective phenomenon appears. The increase of the different soluble sulphur fractions in the skin in anagen phase is equal after cysteamine and cystamine. These modifications do not explain the difference in radioprotective action, but it seems to be connected with the degree of oxygenation at the hair bulb level, itself related with a quantitatively different pharmacological action of these substances on the blood circulation. Cysteamine provokes a light and passing hypoxia, while cystamine causes an important and prolonged fall of oxygen pressure. (GE)

30177 EFFECTS OF RADIATIONS ON SUCCINATE DEHYDROGENASE LEVELS IN TESTES AND EPIDIDYMIS OF RATS, MICE, AND GUINEA-PIGS. Chinoy, N. J.; Shah, V. C.; Bhatavdekar, J. M. (Univ. of Gujarat, Ahmedabad, India). Strahlentherapie; 145: No. 6, 720-724(1973).

Succinate dehydrogenase (SDH) activity was estimated biochemically after low-level x-irradiation in guinea pigs, rats, and mice. The normal concentration of SDH was higher in the epididymis of mice than in those of rats and guinea pigs. On the other hand, rat testes possessed higher SDH activity as compared to the testes of the other two animals. On the whole, low-level radiations did not cause a permanent damage to the tissues investigated, as the epididymal and testicular SDH were either activated or restored to normal levels after three days except in the rat, where the inhibition was most significant. The recovery in epididymal and testicular SDH activity in these animals is explained and the significance of the data with regard to sperm mobility and metabolism as well as induction of temporary sterility for short duration are discussed. (GE)

30178 AUTORADIOGRAPHIC DATA ON THE PARTICIPATION OF IRRADIATED TISSUES IN THE PROCESS OF AXOLOTL EXTREMITY REGENERATION SUPPRESSED BY X-RAY IRRADIATION. Tuchkova, S.Ya. (Inst. of Biological Development, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 4, 986-988(1 Jun 1973). (In Russian).

Even though irradiated tissues may apparently participate in regeneration processes, it is possible that the source of regeneration may be cells of unirradiated tissues that migrate through the irradiated region to the amputated extremity. Tritiated thymidine was used to tag the irradiated tissue, while the transplanted ma-

terial did not contain H^3-thymidine. The tagged thymidine was injected one day before giving the amputated extremity an x-ray dose of 6000 R. The distribution of tagged and untagged cells was followed by staining and by taking radioautographs. The results showed that the homotransplantation of irradiated tissues into the irradiated extremities of the Axoloti was effective in establishing regeneration in 50 to 60% of the cases, but not in 100% of the cases. The regeneration takes place as a result of the unirradiated tissues of the transplant, and also of some of the irradiated tissues. (SJR)

30179 EFFECT OF X IRRADIATION ON THE CONDITIONED MOTOR REFLEX ACTIVITY IN YOUNG RATS. Kharchenko, P. D.; Chaichenko, G. M.; Elmuratov, S. (Kiev State Univ.). Fiziol. Zh., Akad. Nauk Ukr. RSR; 19: No. 4, 441-448(1973). (In Ukrainian).

The whole-body x irradiation of young albino rats (3 to 4 months) in doses of 500, 600, and 700 R causes a distortion in the conditioned reflex activity: an increase in the latent period and duration of the reflex as well as the number and magnitude of interval reactions. With intensive doses (600, 700 R) these variations were biphasic; immediately after the exposure (1 to 7 days) and after a relative stabilization period (18 to 24 days). The total x irradiation also evokes a biphasic decrease in total animal activity on the 5 to 7th and 18 to 24th days. The radiation effect initiates predominantly a significant weakening of inhibition soon after irradiation (4 to 7 days) and 2 to 3 weeks after the exposure to x rays. (auth)

30180 BIOLOGICAL RADIATION EFFECT ON INCLUSION OF MODERATELY HEAVY NUCLEI IN THE TISSUE AND THE APPLICATION OF SOFT X-RAYS. Tisljar-Lentulis, G. (Kernforschungsanlage, Juelich, Ger.); Feinendegen, L. E.; Bond, V. P. Strahlentherapie; 145: No. 6, 656-662(1973). (In German).

Electrons of extremely low energy are of high radiobiological effectiveness. This is demonstrated by incorporated emitters of Auger electrons. Induction of the emission of such electrons is possible by K- and L-absorption of soft x rays, the target atoms of which may be either injected directly into the tissue to be irradiated or incorporated into the DNA of cells, like bromine or iodine. A merit factor of irradiation efficacy was defined and calculated for a variety of target x ray combinations. It shows that elements 28 to 48 qualify best for targets, depending on the problem to be solved. The factor for iodine is 16% lower than the highest value in this range of elements. The energy deposited by the electrons from one vacancy in the K-shell of iodine is 4.6 keV per standard cell nucleus of 2.7×10^{-10} g. Theoretical considerations are made as to the effect of induced electron emissions on the growth of sarcomas in mice following the injection of a solution of iodouracil. Reference is made to the clinical significance of the findings. (GE)

30181 CHROMOSOMAL INTERCHANGES INDUCED BY RADIATION IN SPERMATOGONIAL CELLS AND LEUKOCYTES OF MOUSE AND CHINESE HAMSTER. Brewen, J. G.; Preston, R. J. (Oak Ridge National Lab., TN). Nature (London); 244: No. 134, 111-113(25 Jul 1973).

A study was made of the frequency of chromosome aberrations observed in mice and Chinese hamster leukocytes and spermatogonial stem cells after x irradiation over a range of 0 to 1000 rad. The dose-response relationship was compared for dicentrics produced in immature leukocytes and analyzed at the subsequent mitosis, and reciprocal translocations produced in spermatogonial stem cells and analyzed at diakinesis in the primary spermatocytes. The slopes of the regressions for dicentric production and reciprocal translocations were similar, but the yields of primary spermatocytes were a quarter of those of the leukocytes, and these results are discussed in relation to an argument for a strong selective pressure operating against spermatogonial cells bearing translocations. It is suggested that the relationship of dicentric yield in the leukocytes of various species might be extended to reciprocal translocations in primary spermatocytes at x ray doses <400 rad. It is also suggested that the dicentric yield could be used to predict the translocation frequency in the F, progeny. (UK)

30182 RAPID RADIATION CELL DEATH AND CELL PROLIFERATION RECOVERY IN INTESTINAL EPITHELIUM AFTER 1000-R IRRADIATION. Tsubouchi, S.; Matsuzawa, T. (Aichi Cancer Center, Nagoya, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 175-179(1972). (In Japanese).

Rapid death of intestinal crypt cells was observed after 1000 R of whole-body x irradiation by direct counting of pycnotic cells in the tissue section. It was found that the number of crypt cells decreased as pycnotic cells appeared after irradiation. Pycnotic cells appeared within 30 min. and reached maximum at 4 hr. after irradiation. The mean life span of pycnotic cells calculated from the disappearance rate of the cells was 2 hrs. or less. The cells observed within 4 hrs. after irradiation were produced in the cell cycle phase when irradiated or at least in the next phase. The frequency of pycnotic cell was high in G_2 phase and S phase, the least in G_1 phase. After quick rejection of damaged cells, rapid recovery of the cell population accompanied by logarithmic cell proliferation and the shortening of the cell cycle was observed. The recovery of the cell population to the normal level was attained within five days after irradiation. (auth)

30183 NATURAL IMMUNITY OF DOGS EXPOSED TO A LONG-TERM CHRONIC GAMMA IRRADIATION. Shilov, V. M.; Pal'mina, S. I.; Markelov, B. A. Kosm. Biol. Med.; 7: No. 5, 23-28(1973). (In Russian).

The results of studying the natural immunity of dogs that were exposed to a 3 year chronic gamma-irradiation are presented. The relationship between changes in the humoral and cellular factors of natural immunity and the irradiation dose was revealed. The animals that were irradiated with a dose of 21 rads per year showed activation of the complementary and bactericidal properties of the blood. The dogs that were irradiated with doses of 125 rads and 62 plus 126 rads per year exhibited changes in immunological reactivity that followed certain phases: stimulation was accompanied by a marked decline. These findings give evidence for large compensatory possibilities of the animal body during a chronic exposure to ionizing irradiation. (auth)

30184 USE OF THE RELATIONSHIP BETWEEN ABSORBED DOSE AND MITOTIC ACTIVITY OF THE BASAL LAYER CELLS FOR JUSTIFICATION OF THE PERMISSIBLE EXPOSURE OF SKIN. Osanov, D. P.; Rackova, V. A. (Inst. of Biophysics, Moscow). pp 77-82 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The kinetics of suppression and recovery of the mitotic activity of the epidermis basal cells were traced from 1 hr. to 6 months after irradiation with doses from 25 to 10,000 rad. The investigations were carried out on pigs, their skin being identical to the human skin. The problem of the connection between the reaction of the skin to the exposure and the alteration in the mitotic activity of the epidermis cells is discussed. (auth)

30185 INFLUENCE OF IRRADIATION ON THE INCORPORATION OF RADIONUCLIDES. Jaworowski, Z.; Bilkiewicz, J.; Radwan, I. (Central Radiological Protection Lab., Warsaw). pp 303-306 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The influence of internal irradiation on the incorporation rate of ^{239}Pu, ^{226}Ra, ^{210}Pb, ^{144}Ce, and ^{3}H in hair and other tissues was studied on rabbits and rats. In tritium experiments, internal irradiation effects were compared with those caused by external x-ray exposure. (auth)

30186 STIMULATION OF HEMOPOIETIC RECOVERY IN IRRADIATED OR CONTAMINATED RATS INDUCED BY 19S ALPHA-2 MACROGLOBULIN. Smid, A.; Simsa, J. (Purkyne Medical Research and Postgraduate Inst., Hradec Kralove, Czech.). pp 353-356 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Macroglobulin (MG) isolated from human plasma and from rat serum and spleens was enhancing the hemopoietic recovery following whole-body irradiation with 700 R. A positive effect was observed also in radiation injury caused by simultaneous external and internal irradiations (700 R + 0.7 μCi/g of ^{89}Sr). In rats contaminated with ^{140}Ba or ^{89}Sr the results cannot be explained unambiguously. In ^{140}Ba contamination the treatment began immediately after the injection of the radionuclide. No positive results were found. In ^{89}Sr contamination the treatment was carried out from the 10th till the 14th day. In this case a favourable effect was reached. The effect of MG depends on the method of preparation. (auth)

30187 ANIMAL EXPERIMENTS. Histologic, Microangiographic, and Angiographic Investigation of Vascular Changes in the Urinary Bladder of the Rabbit After Irradiation or Bacterial Infection. Hassler, O.; Hietala, S. O. Acta Radiol., Suppl.; No. 328, 1-40(1973).

A microscopic, microangiographic, and angiographic examination of the urinary bladder of 83 rabbits was performed. Fifty-three of these animals were exposed to irradiation over the urinary bladder (1600 to 2400 rad) and examined after one to 18 months. Twenty were infected with Escherichia coli and 10 served as controls. An increase in the number of dilated vessels with increased tortuosity was demonstrated in both the irradiated and

the infected animals. The changes were observed at both early and late stages after irradiation. In addition, irregular variations in the calibre of the blood vessels, that could have represented early teleangiectases, were observed in the irradiated animals. Similar changes were noted in a few of the infected animals, but in the majority of the cases there were no changes of this type. They could be demonstrated by microangiography, but not by angiography. (SW)

30188 EFFECT OF EXTERNAL WHOLE-BODY X IRRADIATION ON GALLIUM-67 RETENTION IN MOUSE TISSUES. Swartzendruber, D. C.; Huebner, K. F. (Oak Ridge Associated Universities, TN). Radiat. Res.; 55: No. 3, 457-468(Sep 1973).

Whole-body and tissue retention of the radionuclide, gallium-67 (^{67}Ga), was determined in adult $C3BF_1$ mice after acute whole-body x irradiation. A significant decrease in whole-body retention occurred after an exposure to 75 R. Decreased retention in soft tissues was a transitory effect and recovery of the ability to concentrate ^{67}Ga was dose dependent within the range of 100- to 950-R exposures. Recovery occurred at Day 3 after 100 R, and between Days 6 and 8 after 450 and 950 R. The radiation effect of decreased retention was most severe when the radionuclide was administered 24 hr after irradiation. In contrast to decreased uptake in soft tissues, ^{67}Ga concentration in whole femur increased after irradiation. Blood levels decreased rapidly in irradiated mice (^{67}Ga injected 24 hr after 450 R) between 1 and 2 hr after administration of the radionuclide. Two hours after injection, its concentration was approximately 15% of that in non-irradiated, control animals. It was concluded that decreased ^{67}Ga retention in mice after x irradiation is in part due to an effect on a relatively radiosensitive, as yet unidentified blood or serum component that normally binds the radioisotope. Other as yet unidentified factors may also be operative, however. (auth)

30189 DEPRESSION OF ANTILYMPHOMA ALLOGRAFT REACTIVITY BY TUMOR-ASSOCIATED FACTORS. Bonmassar, E.; Bonmassar, A.; Goldin, A.; Cudkowicz, G. (Univ. of Perugia, Italy). Cancer Res.; 33: 1054-1061(May 1973).

Relatively small numbers of viable or killed tumor cells (10^2 to 10^5) of five transplantable mouse leukemias and one carcinoma were inoculated into syngeneic or allogeneic adult mice. The inoculations depressed the allograft reactivity of the recipients as judged from reduced resistance to the growth of a second transplant of 10^6 to 10^7 H-2-incompatible strain-specific lymphoma cells. A single injection of the most effective conditioning cells caused long-lasting depression of antilymphoma reactions (up to 3 months) regardless of whether the H-2 antigens of challenging and conditioning tumors were different or alike. The active factor was extractable from cells in suspension and separable by filtration through Millipore membranes. Of 338 mice pretreated with tumor material under a variety of conditions and schedules, 326 were rendered susceptible to allogeneic lymphoma grafts, whereas only 19 of 219 untreated control mice failed to reject the tumors. Depression of antilymphoma reactions was not caused by cells of normal spleen and of two other leukemias and one carcinoma. However, lactic dehydrogenase-elevating virus, a contaminant of all tumors used, and Moloney sarcoma virus did cause nonspecific depression, thus imitating the tumors. Depressive factors capable of breaking the major histocompatibility barrier of the species (possibly viruses, viral products, or tumor cell products) were associated with as few as 100 neoplastic cells. If this association would also occur during oncogenesis, it could favor the escape of antigenic tumors from host surveillance. (auth)

30190 RELATIVE RESISTANCE OF EARLY MEMORY CELLS IN MICE PRIMED WITH SHEEP ERYTHROCYTES TO CYTOTOXIC EFFECTS OF ANTI-THETA SERUM. Byfield, P.; Salerno, A. (Wellcome Research Labs., Beckenham, Eng.). Cell. Immunol.; 7: 328-331(1973).

Within a few days after injection of sheep erythrocytes (SE), mice become able to make an accelerated response to a second injection of SE, as determined by both direct and indirect plaques and serum antibody. This early priming or quick response capacity can be transferred to irradiated recipients by spleen cells that adhere to glass. The experiments reported herein show that the cells thus primed are relatively resistant to cytolysis by anti-θ serum and complement. (auth)

30191 EXPERIMENTAL REORGANIZATION OF THE CEREBELLAR CORTEX. IV. Parallel Fiber Reorientation Following Regeneration of the External Germinal Layer. Altman, J. (Purdue Univ., Lafayette, IN). J. Comp. Neurol.; 149: 181-192(15 May 1973).

The heads of Long-Evans hooded rats were irradiated with a schedule of low-level x radiation, which allowed regeneration of the external germinal layer. In the subsequently regenerated molecular layer, parallel fibers were often reoriented. In some cerebella this was restricted to a single lobule, frequently several lobules were affected, rarely almost the entire vermis. It was postulated that the reorientation of parallel fibers was determined by the invasion route of multiplying cells from spared foci of the external germinal layer. Where parallel fibers were rotated transversely, the axons of basket cells and the arborizing dendrites of Purkinje cells became oriented longitudinally. This, and other considerations indicated that parallel fibers exert a guiding influence on the pattern of growth of the spiny branchlets of Purkinje cells. (auth)

30192 EXPERIMENTAL REORGANIZATION OF THE CEREBELLAR CORTEX. III. Regeneration of the External Germinal Layer and Granule Cell Ectopia. Altman, J. (Purdue Univ., Lafayette, IN). J. Comp. Neurol.; 149: 153-180(15 May 1973).

The heads of Long-Evans hooded rats were irradiated daily from day 3, 4, or 6 onward with schedules of low-level x radiation, which differently delayed the regeneration of the subtotally eradicated external germinal layer or prevented its regeneration altogether. Most schedules that permitted regeneration led to the arrest of many granule cells in the molecular layer where they formed an ectopic zone. The dendrites of ectopic granule cells had synapses with mossy fibers located in their vicinity in the molecular layer. The position of the ectopic zone varied in different lobules depending on several factors: the time when regeneration began, the estimated date of descent of granule cells, regional differences in cortical maturation and in the estimated upward growth rate of mossy fibers. Within the same lobule, the longer regeneration was delayed the higher in the molecular layer the differentiating and descending granule cells were captured by the apparently autonomously ascending mossy fibers. If regeneration started early and allowed the descent of granule cells into the granular layer (early irradiation) or if regeneration of granule cells was prevented altogether (late irradiation) an ectopic zone was not formed. The technique was used for estimating the normal growth pattern of mossy fibers in the different lobules. (auth)

30193 IMMUNOLOGIC PROPERTIES OF MOUSE THYMUS CELLS: MEMBRANE ANTIGEN PATTERNS. Associated with Various Cell Subpopulations. Konda, S.; Stockert, E.; Smith, R. T. (Univ. of Florida, Gainesville). Cell. Immunol.; 7: 275-289(May 1973).

The membrane antigen components of mouse thymus cells and fractions derived from BSA density gradient centrifugation were assayed by quantitative cytotoxicity tests. Two subpopulations were identified on the basis of average density and antigen patterns. The major subpopulation consisted of small lymphoid cells and comprised 80%-90% of all cells, was of high relative density and rich in θ, TL, G_{1x}, Ly-A, Ly-B, and Ly-C, but contained little or no H-2. The minor subpopulation was chiefly large lymphoid cells, comprised 10%-15% of cells, was of low relative density, was relatively rich in H-2 but low in θ and Ly antigens, and contained no detectable TL or G_{1x}. This minor subpopulation was identical in density and antigen patterns to those cells remaining in the thymus after short-term cortisone treatment or whole-body irradiation. It could also be reproduced by treating whole thymus with anti-TL or anti-θ sera. The antigenic attributes of this minor subpopulation differed from those of spleen lymphocytes only with respect to average density. (auth)

30194 RESPONSE OF VIABLE TUMOR CORDS TO A SINGLE DOSE OF RADIATION. Tannock, I.; Howes, A. (Univ. of Texas, Houston). Radiat. Res.; 55: No. 3, 477-486(Sep 1973).

A C3H mouse mammary tumor contained cords of viable tissue separating vascular and connective stroma from regions of necrosis. The mean distance from capillary to necrotic tissue was about 90 μm, a value close to the calculated diffusion distance for oxygen. Doses of 600 and 2000 rads γ radiation to the tumor caused increasing delays in tumor growth but no significant reduction in volume; 3000 rads given under conditions of acute local hypoxia caused slight tumor regression followed by slow regrowth. After each of these doses the mean thickness of tumor cords shrank rapidly to about 50% of the control value at about 12 hr after irradiation, and then started to increase. The mean concentration of cells within the tumor cords also decreased after irradiation. Thus, changes in tumor volume were not representative of microscopic changes in cell number. The rate of recovery of cord thickness was dose dependent, and after 2000 rads or 3000 rads hypoxic cords regrew to a mean thickness less than that in unirradiated tumors. Changes in tumor oxygenation with time after irradiation are dependent on these changes in microarchitecture and are compared with rates of reoxygenation that were estimated by other methods. (auth)

30195 EFFECTS OF ADRENOCHROME MONOGUANYLHYDRAZONE METHANESULFONATE GIVEN BEFORE OR AFTER IRRADIATION ON THE INDUCTION OF CHROMOSOME ABERRATIONS. Kobayashi, J. (Tokushima Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 2, 126-129(Feb 1973).

Adrenochrome monoguanylhydrazone methanesulfonate (AMM) was injected into mice intraperitoneally on the 6th day after the transplantation of ascites tumor cells. It was injected at a dose of 5 mg/kg 15 min before or 5 hr after whole-body irradiation of the mice. Mice were irradiated with 500 R from a Toshiba therapeutic x-ray machine. Breaks in chromosomes and chromatids were scored in each experiment. Values were calculated from the results on about 50 to 100 metaphasic cells examined 24 hours after irradiation. In control samples, 6% of the metaphasic cells had chromatid breaks but no chromosome breaks were observed. The aberration rate per chromosome was 8.3×10^{-4}. After irradiation with 500 R without AMM treatment, 48% of the cells showed chromosome aberrations with average of 0.68 chromatid breaks and 1.82 chromosome breaks per cell. The aberration rate per cell was 2.48. The aberration rate per chromosome was 3.3×10^{-2} and the aberration rate/cell/R was 4.8×10^{-3}. In samples from animals treated with AMM before irradiation, 38% of the cells showed chromosome aberrations, with averages of 0.46 chromatid breaks and 1.64 chromosome breaks per cell. The aberration rate per cell was 2.10 and the aberration rate per chromosome was 2.9×10^{-2}. The aberration rate/cell/R was 4.2×10^{-3}. In cells from mice treated with AMM after irradiation 48% of them had chromosome aberration with 0.42 chromatid breaks and 1.46 chromosome breaks per cell. The aberration rate per cell was 1.88 and the aberration rate per chromosome was 2.7×10^{-2}. The aberration rate/cell/R was 3.8×10^{-3}. (auth)

30196 ROLE OF LIVER NUCLEAR PROTEINS IN IMMUNITY AND IRRADIATION. Kitulescu, I.; Dumitriu, A.; Leibovici, I.; Curca, L. Oncol. Radiol.; 11: No. 3, 215-222(1972). (In Rumanian).

Quantitative variations of nuclear proteins (basic, acid and residual) were determined in the liver of normal and tumour-bearing rats, after total irradiation with 500 R, immunization with various amounts of antigen (human serum albumin) and immunization after thiaminepyrophosphate treatment (for increasing immunological reactivity). In the liver of the tumour-bearing animals there was an increase in nuclear proteins, especially residual ones, as compared to normal control values. The conditions used influence the amount of proteins to various extents and in different senses, according to the experimental pattern. Immunization has a stronger effect than irradiation, obtaining higher quantitative values of nuclear proteins both in the normal rat liver and in that of tumour-bearing animals. Summation of the effect is obtained by associating irradiation with immunization. The strong, separate effects of irradiation and immunization appear to be attenuated when the two are combined, or even suppressed, as if a competitive relationship interfered. The results obtained, showing the interrelationship between the mechanism of irradiation, immunization and carcinogenesis, suggest new possibilities of therapeutical interventions, by associating radiosensitization with various types of immunization. (Rom. Sci. Abstr.)

30197 IMMUNOLOGICAL MEMORY IN MICE AFTER IRRADIATION AT LETHAL DOSES WITH SHIELDING OF THE LEGS. Khaitov, R. M.; Panteleev, E. I. (Inst. of Biophysics, Moscow). Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 6, 19-22(Jun 1973). (In Russian).

In non-uniformly irradiated mice preservation of the immunological memory to antigens with which the organism made contact until the irradiation was observed. The display of the effect of immunological memory preservation in non-uniformly irradiated mice is related to the presence in the organism of cells of non-irradiated bone marrow. The cells of immunological memory do not in themselves have increased radioresistance. (tr-auth)

30198 RADIOSENSITIZING EFFECT OF IODOACETAMIDE ON SOME EXPERIMENTAL TUMORS. Furnica, M.; Ganea, A.; Spiridon, M.; Sandulescu, T. Oncol. Radiol.; 11: No. 3, 249-258 (1972). (In Rumanian).

Iodoacetamide (IAA) in doses of 15 mg/kg body weight reduces survival of mice irradiated with 100 to 700 R, in the period after irradiation. Administered to rats with Walker tumours, IAA sensitizes the tumour to the action of local irradiation with 5000 R, slowing down the growth. Administered to rats with Jensen tumours, IAA allows a reduction of the efficient therapeutical irradiation dose from 5000 R to 3000 R, resulting in the resorption of the tumours. IAA alone, without irradiation, does not influence tumoural growth. (Rom. Sci. Abstr.)

30199 THERAPY OF RADIATION DAMAGE IN MICE WITH O-(β-HYDROXYETHYL)-RUTOSIDE. Bruecker, V. (Univ., Hamburg). Strahlentherapie; 145: No. 6, 731-734(1973). (In German).

In a mammalian organism, a massive irradiation causes vascular damages induced by thrombocytopenia. This again leads to internal hemorrhages and the invasion of bacteria into the bloodstream. Because of the lymphocytopenia and granulocytopenia also induced by radiation, the resistance of an organism against infection is greatly reduced. Here the critical phase of the acute radiation syndrome begins, which often ends fatally. We therefore wondered whether it would be possible to obtain a treatment for the radiation damage in mice with a vaso-stabilizing agent. As a suitable substance we chose the semi-synthetic flavonol glycoside O-(β-hydroxyethyl)-rutoside. When this flavonoid was applied orally after the exposure, the survival rate of the whole-body x-irradiated mice was increased significantly from 31% to 56%. Because of the fact that this substance has already been in use for many years in human medicine there is perhaps a possibility of treating radiation sickness in men successfully with this drug, since blood transfusions and especially bone marrow transplants are still problematical. (auth)

30200 CHARACTERIZATION OF A NEW LYMPHOID CELL TYPE DETECTED IN THE IRRADIATED MOUSE. Haot, J.; Betz, E. H.; Revesz, L. (Univ., Liege). Nature (London). New Biol.; 244: No. 137, 211-212(15 Aug 1973).

After sublethal x irradiation, accumulation of lymphocytes and lymphocyte-like cells was observed in recovering mouse bone marrow. The accumulation was transitory, lasting from the 10th to the 14th day, with a maximum on the 12th. Its extent and duration were independent of dose in the range 80 to 500 R. Cytological studies have indicated that especially on the 12th day, large numbers of a cell type (designated X), not seen in normal adult bone marrow, were present. Immunological and functional experiments on the nature of X cells are reviewed. Tests with lymphotoxic agents indicated that they are lymphoid. Spleen colony forming capacity was studied after lethal x irradiation in mice, the results suggesting that X cells cannot function as pluripotent hemopoietic stem cells. Radioactive iron incorporation into bone marrow in combination with cytological investigation of the myelogram from irradiated mice showed that erythroid and myeloid recovery was independent of X cell accumulation. Preliminary experiments have indicated that X cells possess embryonic antigens. Attention is drawn to other work (Kaplan, H. S., Fed. Proc., 19, 399 (1960)), showing similarities in the experimental induction and prevention of X cell accumulation and thymic lymphomas, and it is suggested that X cells may present a specific target for a radiation leukemia virus. (UK)

30201 X-RAY-INDUCED TRANSLOCATIONS IN SPERMATOGONIA. I. Dose and Fractionation Responses in Mice. Preston, R. J.; Brewen, J. G. (Oak Ridge National Lab., TN). Mutat. Res.: 19: No. 2, 215-223(Aug 1973).

The frequency of reciprocal translocations, induced by x-irradiation of mouse spermatogonial cells and observed at diakinesis-metaphase I in primary spermatocytes, was measured over a dose range of 0 to 1200 R. The resulting dose-response curve gave a best fit to the model $Y = bD + cD^2$ over the range 0 to 500 R. Above 600 R, however, the yield of translocations decreased with increasing dose, leading to a humped dose-response curve over the whole dose range studied, as was observed by several workers previously. The significance of the nonlinear dose-response curve over the lower dose range is discussed in terms of the known fractionation and dose-rate effects for reciprocal translocations induced in spermatogonia. A dose of 800 R was split into two 400-R fractions separated by 8 weeks, or one of 1200 R into three equal parts, each separated by an 8-week interval. The resulting yield of translocations was the same as the sum of two, or three, separate 400-R doses, but was much higher than a single dose of 800 or 1200 R. It is suggested that these results, namely the shape of the dose-response curve and the reverse fractionation effect, can be explained in terms of resistant and sensitive stem-cell populations, but that any one cell can be in either population, depending on the stage of the cell cycle in which it is at the time of irradiation. (auth)

30202 IN VIVO MEASUREMENT OF ^{32}P-INCORPORATION IN CARCINOMAS OF WHITE MICE, NOT IRRADIATED OR IRRADIATED BY X-RAYS. An Experiment to the Problem of Individual Therapy. Pfeiff, H.; Strack, H.; Rausch, L.; Linhart, G. (Univ., Giessen, Ger.). Strahlentherapie; 145: No. 6, 702-719(1973). (In German).

On the example of the ^{32}P-incorporation of not irradiated and irradiated Ehrlich-carcinomas in white mice—taken as a rough radiotherapeutic model—radiobiological parameters are demonstrated by application of a special measuring technique under in-vivo-con-

ditions; the possibility of a radiotherapy controlled by means of technical measurements is discussed. (auth)

30203 EFFECT OF DIFFERENT FRACTIONATED REGIMES OF WHOLE BODY RADIATION ON THE ^{59}Fe UPTAKE IN THE CIRCULATING ERYTHROCYTES OF RATS. Bose, A. (Medical Coll. Hospital, Calcutta). Indian J. Radiol.; 25: No. 4, 271-273 (1971).

The effect of subcutaneous injection of radioactive iron following irradiation is reported. A total dose of 900 rads was given. The smaller number of fractions was much more effective in depressing iron incorporation in the circulating erythrocytes than the larger number of fractions. The percentage of normal controls is compared with calculated equivalent single doses and discussed with reference to results reported by others from cell survival curves and published clinical data. (Indian Sci. Abstr.)

30204 CHANGES IN THE STRUCTURE OF THE CARDIAC CYCLE FOLLOWING CHEST X IRRADIATION IN RABBITS. Dzhandzhgava, M. M.; Nadareishivili, K. Sh.; Sharashenidze, N. B. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 2, 445-448(Aug 1973). (In Russian).

Continuous x radiation (dose rate 350 to 400 rad per min.) of the chest before development of the terminal stage does not produce any conspicuous changes in the structure of cardiac cycle or a considerable myocardial insufficiency. Changes in the hemodynamics and respiration preceding the terminal stage account for the development of severe general hypoxia, while this latter must be the sole reason of cardiodynamic disturbances. These facts indicate that a hypodynamic syndrome of the myocardium manifesting itself after total irradiation does not seem to be a direct effect of radiation on the myocardium and its peripheral regulating mechanisms. (auth)

30205 PATHOARCHITECTONIC CHANGES IN THE CNS OF EXPERIMENTAL ANIMALS UNDER THE ACTION OF IRRADIATED DOG'S PLASMA. Tskhadadze, M. Sh. Soobshch. Akad. Nauk Gruz. SSR; 71: No. 2, 477-480(Aug 1973). (In Russian).

Intramuscular injection of the blood plasma of an animal exposed to irradiation causes significant structural changes in a healthy experimental dog's brain: swelling of nervous cells, cytoplasm vacuolization, curving of dendrites, change of chromatin configuration and its redistribution, nuclear swelling, neuron reimpregnation, swelling and changes of telodendrions. The number of perineural satellites also increases. The above changes take place in the cortex of the cerebral hemispheres, particularly in the external complex of the cortical layers of the 4th and 17th areas. In the cerebellum and the medial region of the optical lobe, these changes are represented weaker. It is worth noting that the experimental data obtained are analogous to the changes caused by the action of the blood plasma of schizophrenic patients on the CNS of experimental animals (dogs). (auth)

30206 CHANGES INDUCED BY X IRRADIATION IN SUCCINATE DEHYDROGENASE LEVELS IN RAT AND GUINEA-PIG TISSUES. Shah, V. C.; Chinoy, N. J.; Bhatavdekar, J. M.; Mojamdar, M. V.; Sharma, K. S. (Gujarat Univ., Ahmedabad, India). Indian J. Exp. Biol.; 11: No. 1, 30-33(Jan 1973).

Effects of x irradiation on succinate dehydrogenase (SDH) were studied in normal, irradiated, and recovering tissues of rat and guinea pig. Rat tissues showed higher SDH activity than those of guinea pig. Liver in both showed highest concentration of SDH. Irradiation caused significant decrease in enzyme concentration in rat tissues except in adrenal glands, where it increased after irradiation. In guinea pig, liver and adrenals were more radiosensitive than kidney and muscle. Two days after irradiation, SDH concentration in guinea pig tissues almost completely recovered, but not in liver, kidney, and muscle of the rat even after 72 hr. The results indicate that rat tissues are more sensitive to x irradiation and take longer to recover than those of guinea pig. (auth)

30207 OBSERVATIONS ON THE THYROID OF WHOLE-BODY X-IRRADIATED GARDEN LIZARD, CALOTES VERSICOLOR (DAUDIN). Maity, L. K.; Ghosh, A.; Banerjee, S. K. (Kalyani Univ., India). Indian J. Exp. Biol.; 11: No. 1, 34-36(Jan 1973).

Whole-body x irradiation with a single dose of 225 or 450 R inhibited thyroid activity in C. versicolor. The degree of such inhibition was more with the higher dose. The hypoactivity of thyroids was gradually increased with time in the 450 R irradiated lizards, but not in the 225 R irradiated ones. The state of thyroid hypoactivity was reflected by changes such as decrease in follicular cell height, flattening of cell nuclei, increase in follicular area as well as increased stainability of colloids and absence of resorption vacuoles. Gross cellular damage in the thyroid follicles was not observed. This thyroidal hypoactivity seemed to be an indirect result of x irradiation. (auth)

30208 EXPERIMENTAL RESEARCH ON RADIATION HAZARDS IN DOGS AND HORSES TREATED WITH X RAYS. Hartung, K. (Freie Univ., Berlin). Berlin. Muenchen. Tieraerztl. Wochenschr.; 86: No. 11, 201-205(1973). (In German).

To determine injuries, healthy animals were irradiated with therapeutic doses. In addition the amount of radiation received by definite organs was measured on models. These researches have shown: In tumor therapy in dogs, temporary general and local reactions can not be avoided, and have to be accepted. X-ray treated tumors in horses are mostly superficially located and limited. Therefore general damages are not probable; reversible local reactions may occur. In treatment of inflammatory conditions in dogs, somatic injuries are not to be expected. The radiation hazards of gonads are mostly so slight, that x-ray therapy in fertile dogs is advisable too. In Roentgen-therapy of lameness in horses, somatic and genetic radiation injuries are not to be expected under optimal irradiation techniques. (auth)

30209 EFFECT OF LETHALLY IRRADIATED CELLS ON THE TRANSPLANTABILITY OF MURINE TUMORS. Hewitt, H. B.; Blake, E.; Porter, E. H. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Cancer; 28: No. 2, 123-135(Aug 1973).

Fully quantitative isogeneic transplantation assays of viable (V) cells of a CBA carcinoma showed that the relationship between long inoculum and frequency of tumor takes accorded strictly with a Poisson distribution and indicated that 6900 cells were required for 50% takes (TD50). Addition of 105 lethally irradiated (LI) cells of the same tumor to the inocula reduced the TD50 to about 4 cells, yet the Poisson relationship was retained. From this and other data it is concluded that LI cells act by increasing the proportion of viable cells that contribute to tumor initiation; there was no evidence that LI cells affected the rate of proliferation of viable cells. The ability of non-homologous LI cells to reduce the TD50 was widely variable, but LI cells of one allografted tumor were almost as effective as homologous LI cells. Lethally irradiated cells did not assist the take of allografted viable tumor cells. Histological comparison revealed no difference of the tissue reaction to inocula of viable and LI cells, and it is questioned whether radiation induced lysis of these latter cells is required for their effect on viable cells. Evidence relating to a hypothesis that viable cells interact with one another as they do with lethally irradiated cells was conflicting. (auth)

30210 EXPERIMENTAL INVESTIGATIONS OF THE ALTERATION OF LOCAL RESISTANCE BEHAVIOR AFTER PARTIAL-BODY IRRADIATION AND LOCAL PRE-IRRADIATION BY MEANS OF FOUR DIFFERENT TEST REACTIONS. Klump, G.; Lux, W.; Rolbetzky, M.; Till, P. Giessen, Ger.; Univ. Giessen (1972). 198p. (In German).

Thesis.

Four local test reactions were performed on NMRI-mice to investigate whether a conditioning, modified whole-body irradiation or a local pre-irradiation will produce an alteration of the radiosensitivity of the tissue under examination. For each of the two experimental series, two different pre-irradiation doses and four different time intervals between conditioning pre-irradiation and test irradiation were chosen. The whole-body pre-irradiation was between $\frac{1}{5}$ and $\frac{2}{5}$ of the $LD_{30/50}$. The doses of the local pre-irradiations were varied according to the radiosensitivity of the test organs. For two test reactions, the animals were sacrificed either soon after irradiation or considerably later, whereas for the other two test reactions the animals were observed over a period of up to 100 d following irradiation. The evaluation of the tests is based on extensive data partly shown in tables given in the annex to this thesis. It was found that a modified whole-body pre-irradiation resulted in an increase of the radiosensitivity in the following three reactions: weight reduction of the testes, ear swelling reaction, and healing reaction of a punched hole in the ear. In the latter reaction, this increase was rather small. In the tail section reaction, a slight decrease of the radiosensitivity was found for one symptom only. After the local conditioning pre-irradiation, the radiation damage induced in the test examining the weight reduction of the testes was found to be partly markedly enhanced in animals sacrificed shortly after irradiation. The test on the healing reaction of punched holes in the ear showed some signs of a retardation of the healing process. The ear swelling reaction revealed a clearly detectable increase in swelling in animals sacrificed shortly after irradiation. As to the tail section reaction, however, rather differing results were obtained. (GE)

30211 EFFECTS OF CERTAIN PEPTIDES OBTAINED BY ENZYMATIC SPLITTING OF BACTERIAL STRUCTURAL PROTEINS ON THE EVOLUTION OF IRRADIATION DISEASE IN MICE. Tomus, L.; Rosenfeld, E.; Suciu, A.; Granescu, S.; Talos, D. Fiziol. Norm. Patol. (Bucharest); 18: No. 3, 223-234(1972). (In Rumanian).

The radioprotective and therapeutic effects of a bacterial extract (BE) were studied on 621 hybrid white mice. The BE was obtained by enzymatic splitting of proteins isolated from bacterial cells containing numerous peptide fractions. The results showed the following: the administration of BE to mice irradiated with 900 rads (LD 93.5% in 14 days) did not reduce the mortality rate and average survival as compared to the controls injected with a normal saline solution ($P > 0.1$); in contrast, in the mice irradiated with a lethal dose, the administration of BE after semilethal irradiation with 600 rads (LD 46.4% in 30 days) lowered the lethality rate to 24.2% and significantly prolonged survival ($P < 0.01$) in comparison with the controls. The administration of BE before and after irradiation with 600 rads shows a still more evident reduction of lethality (to 16.5%). The possibility is discussed of obtaining bacterial peptides by laboratory procedures and their use in radioprotection and treatment of the irradiation disease in view of their stimulating effect upon the immune mechanisms. As compared to other immune stimulating procedures, the BE has the advantage of acting in very small immune stimulating procedures, the BE has the advantage of acting in very small doses and being better tolerated than endotoxins or other antigenic components of bacterial origin. (Rom. Sci. Abstr.)

30212 TOLERANCE OF SK-INCOMPATIBLE SKIN GRAFTS. Boyse, E. A.; Carswell, E. A.; Scheid, M. P.; Old, L. J. (Sloan-Kettering Inst. for Cancer Research, New York). Nature (London); 244: No. 5416, 441-442(17 Aug 1973).

Some experimental results are given on the prompt rejection of H-2 incompatible skin grafts by radiation chimaeras, on the acceptance of Sk-incompatible (A) skin grafts by lethally irradiated B6 mice restored with (B6 × A) hemopoietic cells and given systemic injections of dispersed A strain epidermal cells, and Sk. 1 specificity of the tolerance produced by A strain epidermal cells. The results confirm earlier conclusions that these chimaeras reject donor skin because they are not immunologically tolerant to Sk. 1 antigen, this being a result of the absence of Sk. 1-bearing cells in the chimaeras. By supplying Sk. 1 antigen, in the form of systemically inoculated epidermal cells, the rejection response to donor skin can be largely or entirely eliminated. (UK)

30213 EXPERIMENTAL REORGANIZATION OF THE CEREBELLAR CORTEX. II. Effects of Elimination of Most Microneurons With Prolonged X Irradiation Started at Four Days. Altman, J.; Anderson, W. J. (Purdue Univ., Lafayette, IN). J. Comp. Neurol.; 149: 123-152(15 May 1973).

The heads of Long–Evans rats were irradiated from the fourth day after birth with a schedule of repeated doses of low-level x radiation, which essentially prevented the formation of basket, stellate, and granule cells in all except the earliest-forming lobules (nodules and uvula). The morphogenic and synaptogenic effects of this treatment were examined with light and electron microscopy in 30 day old animals, with particular attention paid to the pyramis. Although when irradiation was started the Purkinje cells formed a monolayer and had upward oriented apical poles, they became scattered later and had randomly oriented dendrites. This secondary disorientation was attributed to insufficient space available in the arrested cerebellum for the rapidly expanding Purkinje cells. Although basket cell terminals were scarce, basket cell-like terminals were formed on the somata of Purkinje cells, apparently by recurrent axon collaterals of these cells. The most common synapses with the thorns of Purkinje dendrites were formed by climbing fibers but other elements, including glial processes, were also in contact with postsynaptic loci on the thorns. Many mossy fiber terminals reached the surface. Where parallel fibers were present they were often thicker than in unirradiated animals and contained neurofilaments. No pathological changes were seen in these cerebella, with the possible exception of excessive lobulation of the nuclei of many Purkinje cells. (auth)

30214 ULTRASTRUCTURE OF ^{60}Co RADIATION PNEUMONITIS IN RATS. Faulkner, C. S. II; Connolly, K. S. (Dartmouth Medical School, Hanover, NH). Lab. Invest.; 28: No. 5, 545-553 (May 1973).

Twelve rats received 3000 rads of ^{60}Co γ irradiation to the right lung with protection of the mediastinum. At intervals of two weeks and two, three, four, and five months, specimens from these animals and controls were studied in light and electron microscopes. Congestion and edema were apparent at the earlier times. At two weeks, the lamellar bodies of the granular pneumonocytes contained an increased amount of more densely stained material. At one month, many granular pneumonocytes were enlarged, and some contained strikingly altered lamellar bodies. Focal endothelial changes were apparent and mast cells were prominent. At two months, in addition to the above, large immature alveolar epithelial cells were present. Mitochondrial alterations were prominent. Interstitial fibrosis began to be apparent. At the later time intervals, most of these changes continued or progressed. Some of the membranous pneumonocytes developed focal thickenings and microvilli. There was a marked reduction in blood vessels. In this experiment, the granular pneumonocyte seemed to be more sensitive than other cell types to irradiation, undergoing both apparent proliferation and marked cytologic changes. The vascular alterations seemed more subtle. The reasons for the discrepancy between these results and those of some of the other workers in radiation pneumonitis are not yet clear. In some ways, the changes in this experiment resemble those reported in a number of other apparently unrelated pulmonary injuries, underlining the limited ways in which the lung can respond to injury. A common observation in this and other laboratories is apparent proliferation of granular pneumonocytes. In spite of several studies, the source and renewal processes of this cell type remain incompletely understood. (auth)

30215 EFFECT OF ANTIPHLOGISTIC AND ANTIPROTEOLYTIC PREPARATIONS ON VASCULAR DISTURBANCES OF THE INTESTINES OF ANIMALS IRRADIATED BY SUPRALETHAL DOSES. Uklonskaya, L. I.; Kudryavtsev, V. D.; Sushkevich, L. N.; Cherkasov, V. F. (Inst. of Medical Radiology, Obninsk, USSR). Byull. Eksp. Biol. Med.; 76: No. 8, 37-39(Aug 1973). (In Russian).

Experiments were conducted on rats irradiated with supralethal doses of ^{60}Co gamma rays (900 and 1000 R). Antiphlogistic (butadion (5 mg/kg), paracetamol (15 mg/kg), and rheopyrine (3 mg/kg)) and antiproteolytic preparations (trasylol (7.5 CIU/kg) in combination with E-aminocaproic acid (200 mg/kg)) were injected intraperitoneally. The functional condition of the vascular wall of the small and large intestines of rats were assessed 72 hrs after the irradiation by the appearance of Evans blue in the intestinal tissues. Butadione, which considerably diminished the amount of stain in the tissue, proved to be the most effective. It also increased the survival period of the irradiated animals, which made it possible to suppose that vascular disturbances played a definite role in the pathogenesis of the intestinal form of radiation sickness. (auth)

30216 ACTION PECULIARITIES OF SYMPATHOMIMETIC AMINES IN RADIATION AFFECTIONS. Loskutova, Z. F.; Saksonov, P. P. (Inst. of Biophysics, Moscow). Byull. Eksp. Biol. Med.; 76: No. 8, 83-85(Aug 1973). (In Russian).

Toxicity of adrenaline, adrenalon, pervitin, phenamine, veritol, ephedrine, and sympathol for irradiated frogs and mice was doubled (or more) in comparison with their toxicity for nonirradiated animals. In comparison with nonirradiated animals, the action of all the seven amines on the reflex activity of the central nervous system of irradiated animals was considerably diminished. The waking action of phenamin and pervitin in the irradiated mice under the action of hexenal was much less than that in the nonirradiated ones. In irradiated animals ephedrine even intensified the hypnotic effect of hexenal. (auth)

30217 EFFECTS OF LOW-DOSE X IRRADIATION ON THE CHROMOSOMAL NON-DISJUNCTION IN AGED MICE. Yamamoto, M.; Shimada, T.; Endo, A.; Watanabe, G. I. (Niigata Univ., Japan). Nature (London) New Biol.; 244: No. 137, 206-208(15 Aug 1973).

The effects of x irradiation on chromosome anomalies in 33 mice (3 to 5 months old) were compared with those in mice of age 11 months. A whole-body x irradiation dose of 5 R was given at a rate of 5 R m^{-1}. There was a significant increase of aneuploid fetuses in the aged as compared with the younger group ($P = 0.02$). Differences in the incidence of chromosome abnormalities between nonirradiated and x-irradiated young adults were not statistically significant ($P = 0.214$). (UK)

30218 CULTIVATION OF MURINE LEUKEMIA CELLS INDUCED BY X IRRADIATION. Iwai, Y.; Okumoto, M.; Takamori, Y. (Radiation Center of Osaka Prefecture, Sakai, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 161-167(1972). (In Japanese).

The splenic leukemia cells derived from a mouse with x-radiation induced reticular sarcoma were converted into ascitic form, and were maintained serially by intraperitoneal injection. The ascites leukemic cells thus obtained were successfully cultivated in vitro. The leukemic cell adapted to long-term cultivation was designated RIL-68 line. At early passages in the cultivation, the leukemic cells adhered less tightly to the glass and tended to be detached in the culture fluid. The culture cells transformed to epithelial-like cells with succeeding passages. The change in cell shape was accompanied by loss of tumorigenicity. The epithelial-like cells had less LDH activity and a greater acid phosphatase activity as compared with the original ascites leukemic cells being maintained in vivo. Electrophoretic analysis demonstrated that the ascites leukemic cells did not produce immunoglobulin. In the XC cell test, the plaque forming activity of Moloney-MLV-infected NIH Swiss mouse embryo cells was inactivated by uv irradiation. The inactivation curve showed one-hit kinetics. (auth)

30219 CELL POPULATION KINETICS OF EPIDERMAL REPOPULATION IN LOCALLY BETA-IRRADIATED GUINEA PIG SKIN. Yamaguchi, T.; Tabachnick, J. (National Inst. of Radiological Sciences, Chiba, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 187-194(1972). (In Japanese).

The alterations in cell population kinetics that result in epidermal repopulation and persistent hyperplasia were studied by autoradiographic methods in guinea pig skin after 3,000 R of local β irradiation from a ^{90}Sr-^{90}Y sealed source. The first sign of an increase in labeling index was observed at the radiation margin about 10 days after irradiation at the time when severe depopulation became evident within the 25mm square irradiated area. Marked hyperplasia became evident at the radiation margin about 12 days after irradiation. Shortly thereafter these cells spread over at an exponential rate over the depopulated zone. In unirradiated epidermis, the mean generation time (Tc) of basal cells was 92 hrs (Tgl = 77, Ts = 9.5, Tg2 = 5.3, and Tm = 0.5 hrs). After irradiation, ^{3}H-TdR labeling index revealed two types of hyperplasia; the first that of the migrating epithelium, consisting of germinative cells with a shortened Tc of about 16 hrs. This shortening of Tc was largely the result of a drastic decrease in Tgl to 3 to 4 hrs. The Tg2 also decreased to 2.5 hrs. The Ts and Tm remained unchanged. After completion of this regenerative epithelization, all the phases of the cell cycle returned to intervals similar to those of the control and persistent acanthotic hyperplasia was established. It persisted for 150 days or longer. The differentiation rate of the epidermal cells underwent a change in parallel with that of the cell cycle. The transit time of cells through the basal-spinous layers was 7 to 8 days in the control, 3 to 4 days during epithelization, and 14 to 15 days in the acanthotic epidermis 50 days or later after irradiation. The main factors contributing to the maintenance of acanthotic epidermis were slower differentiation rate and a greater number of DNA synthesizing basal-spinous cells per unit length. (auth)

30220 ROLE OF THE THYMUS IN THE RECOVERY OF IMMUNE COMPETENCE OF LETHALLY IRRADIATED MICE PROTECTED WITH SYNGENEIC BONE MARROW. Sado, T.; Kamisaku, H.; Kurotsu, T. (National Inst. of Radiological Sciences, Chiba, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 195-201(1972). (In Japanese).

Kinetics of the recovery of immune competence of lethally irradiated, bone marrow protected mice (10-week old C3H/He males) was studied. At varying intervals after lethal irradiation and syngeneic bone marrow treatment, an optimum dose of sheep erythrocytes (2.5×10^{8}) was injected intraperitoneally into the treated animals and their spleens were assessed for contents of hemolytic plaque forming cells 6 days later. It was found that the antibody forming capacity of these treated mice reappeared abruptly at the end of the third week, followed by a gradual increase until a nearly complete restoration to the control level was achieved by the 10th week. When the recipient mice were thymectomized prior to the irradiation and bone marrow treatment, recovery of the immune competence was extremely low but there was a significant recovery at 3 to 4 weeks. An analysis of the survival curve of extrathymic immunocompetent units; i.e., the immune reactivity of the thymectomized irradiated mice, determined at 4 weeks after irradiation, strongly indicated that the observed recovery of the immune competence was not due to a fraction of immunocompetent cells surviving the lethal irradiation but was due to a population of immature immunocompetent cells derived from the donor bone marrow. Available data suggest that they are most likely the thymus-derived, pre-antigen reactive cells that mature as fully competent antigen reactive cells at extrathymic sites without an influence of the thymus. Furthermore, thymic humoral factor(s) that was claimed to be responsible for differentiation of immunocompetent cells could not be demonstrated in the present system. (auth)

30221 SENSITIZING ABILITY AND TOXICITY OF IODOACETAMIDE IN RADIOTHERAPY OF A C3H MOUSE MAMMARY CARCINOMA. Urano, M.; Tanaka, N.; Hayashi, S. (Kyoto Prefectural Univ. of Medicine). Brit. J. Cancer; 28: No. 2, 190-193(Aug 1973).

The radiosensitizing effect of iodoacetamide was studied in a C3H mouse mammary carcinoma together with its toxicity to the host. TCD_{50} or radiation dose to yield 50% tumor control frequency was determined in tumors treated or untreated with the agent. Results indicated that 15 mg/kg of iodoacetamide sensitized hypoxic tumor cells, as did atmospheric oxygen, and the sensitization was not detectable below this dose. Experiments with fractionated treatments suggested that the reoxygenation occurring during the treatment intervals of 24 hrs might be more important in the sterilization of tumor cells than the agent. (auth)

30222 CHANGE IN THE NUMBER OF STEM CELLS IN THE SPLEEN OF PARTIALLY HEPATECTOMIZED MICE AT VARIOUS PERIODS OF HEPATIC REGENERATION. Babaeva, A. G.; Alekseeva, N. Yu.; Gambarov, S. S.; Golovistikov, I. N. (Inst. of Human Morphology, Moscow). Byull. Eksp. Biol. Med.; 76: No. 8, 106-108(Aug 1973). (In Russian).

Twenty four hours after lethal irradiation of hybrid mice, a suspension of splenic cells obtained from intact and partially hepatectomized mice was injected. On the 8th day after the cells transplantation the number of colonies of hemopoietic cells in the spleen and mitotic activity in the liver of recipients were determined. The number of colonies in the spleen of the operated mice diminished 19 to 21 hrs and increased 48 hrs after the operation (statistially significant values). Injection of the splenic cells to irradiated mice stimulated proliferative activity in the liver. The greatest stimulating action was produced by the cells of the donor spleen 17 hrs after partial hepatectomy. The appearance in the cells of the spleen of partially hepatectomized mice of the capacity to induce proliferation in the liver of unoperated recipient was independent of the number of hemopoietic stem cells in the donor spleen. (auth)

30223 EXPERIMENTAL ESTIMATION OF THE BOUNDARY BETWEEN G_0 AND G_1 PERIODS AT RAT REGENERATING LIVER CELLS. Malinovskii, O. V.; Mikhailova, N. Ya.; Sizaleva, N. Ya.; Sheikina, T. A. (Leningrad Inst. of Nuclear Physics). Tsitologiya; 15: No. 8, 1048-1051(Aug 1973). (In Russian).

A time-dose fractionation of x irradiation with 1 hr interval between separated exposures, was used as a test for estimation of the transition from G_0 to G_1 phases in rat liver cells after partial hepatectomy. The dose fractionation was not effective if the intact body irradiation was performed or if rats were x-irradiated 3 hrs following hepatectomy. At 4 hrs or more, the dose fractionation caused an increased ratio of non-aberrant anaphases, if compared with a single exposure by the whole dose. It was concluded that the transition from G_0 to G_1 phases occurs 4 hrs after hepatectomy. (auth)

30224 RADIOAUTOGRAPHICAL INVESTIGATION OF DIRECT AND INDIRECT EFFECTS OF X-RAY IRRADIATION ON RAT TONGUE EPITHELIAL CELL. Ketlinskii, S. A. (Inst. of Experimental Medicine, Leningrad). Tsitologiya; 15: No. 7, 944-948(Jul 1973). (In Russian).

Radioautography was applied to studies into cellular mechanisms of alterations occurring on the dorsal surface of rat tongue epithelium due to an indirect x-ray irradiation (whole-body irradiation). In the first set of experiments when ^{3}H-thymidine was administered 1 hr before killing the animals, the indirect irradiation was shown to decrease DNA synthesis rate without any drop in the amount of labeled cells. The data obtained allowed the mechanisms of mitotic inhibition at direct and indirect irradiations of the tongue epithelial cells to be distinguished. In the second set of experiments with the delay of thymidine labelling, some delay was revealed as to the movement of labeled cells in body-irradiated animals that seemed to be related with the inhibition of cell division at early stages of experiments. A suggestion was made that due to this delay the cell maturations may occur in the spinous layer rather than in the granular one resulting in the enhanced keratinization pattern. (auth)

30225 REPAIR POTENCY AND AGING IN ORGANISMS. Change in Regeneration Rate With Age in the Teleost, Oryzial Latipes. Egami, N. (Tokyo Univ.). Saibo Seibutsugaku Shinpojiumu; 23: 203-206(1972). (In Japanese).

The first half of the paper reviews studies of age-associated changes in repair potency in cells and in cell populations of organisms. In the latter half, some topics indicating that age affects rate of regeneration of tissues in multicellular animals are discussed. In regenerating liver of rats and mice, progressive changes in mitotic and DNA synthetic activities are different among animals of different ages. The relation between age and regeneration rate of the tail fin was shown in female guppies by Comfort and Doijanski (1958). The present author has pointed out the presence of recovery processes from radiation injury after whole-body irradiation in the small fish, Oryzias latipes by x-ray dose fractionation experiments (Egami, 1969). Recently it was found that the recovery processes are more rapid in young fish than in old ones. Furthermore, biological repair takes place in cell populations in the fin more rapidly in young fish than in old fish. From these findings, importance of the decrease in repair potency during aging processes of organism is emphasized. (auth)

30226 PROTECTIVE EFFECT OF 5-HYDROXYTRYPTAMINE ON THE HEMATOPOIETIC STEM CELLS OF MICE. Vacek, A.; Rakova, A.; Rogozhkin, V. D. (Ceskoslovenska Akademie Ved, Brno). Strahlentherapie; 146: No. 1, 104-114(1973).

The protective effect of 5-hydroxytryptamine (5-HT) on the hematopoietic stem cells in mice, in dependence on the dose of 5-HT, route of administration, and the time interval between its

application and irradiation was investigated. The protective effect of 5-HT is correlated with the 30-day survival of mice after a whole-body x irradiation and with the change in the oxygen tension in the spleen. After 5-HT per os application, no protective effect was observed. The intraperitoneal injection of 5-HT is followed by a protective effect, the highest level of which was registered within the first 10 min after the injection; thereafter, a decrease occurred. After the subcutaneous injection of 5-HT, on the other hand, the protective effect of 5-HT on the hematopoietic stem cells remains statistically significant till 45 min after the injection. Two steps in a dose dependence of 5-HT were observed: in doses of 5 to 10 mg protection after intraperitoneal application only was found, while 5-HT in doses of 25 to 100 mg protected as after i.p. and as after s.c. injection. Induction of tissue hypoxia indicated a higher sensitivity to 5-HT applicated intraperitoneally than subcutaneously. (auth)

30227 EFFECTS OF X IRRADIATION ON THE INCORPORATION OF THYMIDINE-^{3}H INTO DNA AND OF L-LEUCINE-^{14}C(U) INTO THE PROTEINS OF RAT SKIN. van der Schueren, E.; Doms, D.; de Wever, F.; De Loecker, W. (Univ., Louvain, Belgium). Strahlentherapie; 146: No. 1, 115-120(1973).

The exposure of the skin to a single x irradiation resulted in an inhibition of thymidine-^{3}H incorporation into DNA and of L-leucine-^{14}C(U) into the proteins. The stimulation of DNA and protein synthesis occurring during the first stages of the hair cycle was totally suppressed by 1500 R and 3000 R, while after 750 R, a delayed stimulatory activity of protein synthesis was observed. The skin-growth phenomenon, as shown by the increasing protein content during the hair cycle, was inhibited by irradiation, while during the main stage of radiation damage transiently increased protein contents were measured. These observations led to the conclusion that the radiation effects on protein synthesis could be due to a mechanism that was independent of DNA damage. (auth)

30228 EFFECTS OF SUBLETHAL, CEREBRAL X IRRADIATION ON MOVEMENT, ACTIVITY, AND HOME-RANGE PATTERNS OF BLACK TAILED JACKRABBITS. Nelson, L. Jr.; Wagner, F. H. (Univ. of California, Davis). Health Phys.; 25: No. 5, 507-514(Nov 1973).

Effects of sublethal, cerebral x irradiation on movement, activity, and home-range patterns of black-tailed jackrabbits were studied in northeastern Utah using radio-telemetry. Irradiation of 70 captive animals using a 200 K.V.A., 8A x-ray machine indicated an $LD_{50(30)}$ between 5556 and 6200 R. Nine wild, free-living experimentals were trapped in desert terrain, field irradiated at a dosage of 5000 R, transmitted, and released at the capture sites. Seven wild controls were treated similarly but were not irradiated. Experimentals had a mean hourly movement of 1176.8 ft and controls 980.0 ft ($P < 0.05$). Experimentals had a bimodal activity curve with peaks at 5:00 p.m. and 3:00 to 5:00 a.m. Controls displayed no such pattern. Experimentals had a mean daily home range of 66.1 acres and controls 34.1 acres ($P < 0.05$). Experimentals had a seasonal home range of 279.0 acres and controls 247.0 acres ($P > 0.05$). A probability index showing the frequency distribution of each animal's activity within 300 ft concentric, circular bands around a geometric center of activity showed similar distributions for controls and experimentals ($P > 0.05$). The greatest activity concentrations were within the innermost band for each group but experimentals had a greater scatter of points in the outermost zone. Sublethal, cerebral irradiation appears to have increased activity levels of experimental animals but not changed those home-range characteristics involving total area occupied and tenacity of site attachment. This increased activity may have resulted from cortex inhibitory areas that permitted greater expression of activity from the limbic system. (auth)

30229 EFFECT OF WHOLE-BODY X IRRADIATION ON INFECTION AND MACROPHAGE FUNCTION. Kambara, T. (Kumamoto Univ., Japan); Hiraoka, T.; Nakaji, T.; Dannenberg, A. M. Jr. Saibo Seibutsugaku Shinpojiumu; 23: 169-174(1972). (In Japanese).

Dermal BCG lesions were periodically measured and biopsies were taken for histological and histochemical evaluation. Macrophages in the granulation tissue around the necrotic foci were highly developed into epithelioid cells and a marked increase in lysosomal and mitochondrial enzymes, especially β-galactosidase. The number of acid fast bacilli in the macrophages and the intensity of staining for β-galactosidase were reversely correlated. Certain macrophages are highly activated in the local lesion and high levels of lysosomal enzymes are involved in the destruction of bacilli. In the whole-body irradiated rabbits with 400 rads of x ray, BCG lesions and tuberculin reactions were smaller indicating less cellular infiltration at about 2 weeks after irradiation. The number of bacilli was greater in the lesions of irradiated group. More bacilli were found in unit area of the tissue sections, more area seemed to contain bacilli, and more bacilli were found in each parasitized macrophage. The effect of irradiation seemed to induce a decreased production of macrophages and seemed to impair the ability of these cells to control the intracellular infection. Biopsies periodically removed were incubated for 1 hr with ^{3}H-thymidine in vitro under hyperbaric oxygen. Twelve to 16 days after irradiation there was a reduction in the percentage of mononuclear cells that had incorporated ^{3}H-thymidine in the lesions. The reduction produced by irradiation in both local cell infiltration and local cell division would decrease the number of macrophage available to control the tuberculous infection in the host. The proteolytic activities of the extracts both of normal and sensitized cells were found at pH 3, 6, and 9, respectively, using hemoglobin and casein as a substrate. In sensitized cell extract, an increase in activities was observed at pH 3 and 6, respectively. This suggests that these proteases may also be involved in cellular allergy and/or immunity in tuberculosis. (auth)

30230 LOCAL REGULATION OF CELL PROLIFERATION AND DIFFERENTIATION IN INTESTINAL EPITHELIUM OF MICE DURING RADIATION DAMAGE RECOVERY PROCESSES. Matsuzawa, T.; Nakayama, T.; Tsubouchi, S. (Aichi Cancer Center, Nagoya, Japan). Saibo Seibutsugaku Shinpojiumu; 23: 181-186(1972). (In Japanese).

The population of epithelial cells in crypt was rapidly reduced after receiving 1000 R, 500 R, and 250 R of x rays. Clear deficiency of the cells in the epithelial linings was observed by rapid cell destruction accompanied by quick rejection. After that, cell population increased drastically and rapidly. There are three mechanisms for such rapid cell repopulation. The higher the doses of x-ray, the larger was the expansion of the proliferative zone. The mode of the cell proliferation changed from the steady state to the exponential form. The cell division occurred more quickly than in the normal state because of the shortening of the cell cycle measured by means of ^{3}H-thymidine autoradiograph. The exponential cell proliferation stopped at 59, 42, and 25 hrs after 1000 R, 500 R, and 250 R of x irradiation respectively. Thereafter, differentiated cell population increased as the standard of the invertase and L-leucine aminopeptidase activities increased with lapse of time. The experiments using ^{3}H-thymidine as the tracer (autoradiography, quantitative analysis of labeled DNA) suggest that the disconnection and the connection of "cell to cell" pull the triggers of cell proliferation and differentiation respectively. (auth)

30231 CHEMICAL PROTECTION OF MAMMALIAN ORAL MUCOSA EXPOSED TO DAILY LOCAL RADIATION. Antone, H. J.; Gibbs, S. J. (Vanderbilt Univ., Nashville). J. Dent. Res.; 52: No. 5, 1153(Oct 1973).

Heads of mice were x-irradiated five days per week until death in doses of 443, 773, or 1070 rads per day. Ten min before each exposure MEA was instilled into the oral cavity and controls received isotonic saline. Survival times were inversely related to dose. MEA extended survival by one day at the two lower doses. Results suggest that MEA may be useful in patients undergoing radiotherapy in the oropharyngeal region. (HLW)

30232 GRANULOCYTIC RECOVERY IN THE POLYCYTHEMIC DOG TREATED WITH ENDOTOXIN POSTIRRADIATION. Pratt, A. G.; Emerson, R. J.; Levin, S.; Baum, S. J. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Radiat. Res.; 56: No. 1, 162-170(Oct 1973).

This experiment was designed to test the hypothesis that, in hypertransfused dogs with suppressed erythropoiesis, endotoxin-induced increased myelopoietic stimulation 24 hr after irradiation would enhance leukocytic recovery. The treatment combination of transfusion polycythemia and endotoxin was compared to a control group receiving no therapy and to the results obtained from groups of dogs receiving each treatment alone. The radiation exposure was 150 rads of total-body x rays. An accentuated abortive rise in the group receiving the combined treatment, accelerated recovery in both groups receiving endotoxin, and impaired leukocytic recovery in the polycythemic animals were observed. Accentuated depression of platelets and inverse correlation of platelet levels with splenic enlargement were observed in the animals receiving transfusion therapy regardless of whether they received endotoxin. It is felt that the data support the concept of interdependence between the various cell lines of hematopoiesis in an experimental model not previously described. (auth)

30233 SITES OF X-IRRADIATION-INDUCED DAMAGE IN THE MICROSOMAL DRUG METABOLIZING ENZYME SYSTEM OF RAT LIVER DURING DEVELOPMENT. Yukawa, O.; Nakazawa, T. (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 56: No. 1, 140-149(Oct 1973).

The effect of x-irradiation at weaning stage on the activity of hexobarbital hydroxylation in male rat liver was studied during

development. The increase of activity at the postweaning period was suppressed partially by 200 R irradiation and completely by 400 R, without remarkable change in the microsomal protein content of liver. Activities of microsomal electron transport system were inhibited only slightly at 40 days of age in 400 R irradiated rats, but both content of cytochrome P-450 and spectral change induced by hexobarbital were suppressed considerably. The activity of hexobarbital hydroxylation relative to the magnitude of cytochrome P-450 spectral change was about 60% lower than that of control. Adenosine triphosphatase and inosine diphosphatase activities were rather higher than those of control, while glucose 6-phosphatase activity was lower than that of control at 40 days of age in irradiated rats. Results are discussed in relation to the mechanism of effects of x-irradiation on the differentiation of drug metabolizing activity. (auth)

Invertebrates

Refer also to abstract 30078.

30234 (CONF-710501-P2, pp 1113-1118) EFFECT OF RADIATION, SALINITY, AND TEMPERATURE ON THE IONIC REGULATION OF THE BLUE CRAB, CALLINECTES SAPIDUS. Engel, D. W.; Davis, E. M.; Angelovic, J. W.; Smith, D. E. (National Marine Fisheries Service, Beaufort, NC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Experiments were designed to define how radiation-salinity-temperature interactions affect the ionic regulation of a euryhaline, poikilothermic crustacean, the blue crab, Callinectes sapidus. Immature blue crabs were exposed to an acute radiation dose of 10,000 rads at various combinations of three temperatures (12, 20, and 28°C) and two salinities (5 and 35 p.p.t.). At predetermined times after irradiation hemolymph samples were collected from the crabs and analyzed for Na^+, K^+, Cl^-, and Mg^{2+} and total free amino acids. Salinity and temperature significantly affected the ionic composition and free amino acid level of the hemolymph, with the highest levels found at the highest salinity. Temperature, however, affected the magnitude of the response and was virtually independent of salinity. Radiation interacted with these two variables to cause alteration in ionic regulation with time after irradiation. Thus the degree of radiation damage to ionic regulation in the blue crab was influenced by the crabs' environment before and after irradiation. (auth)

30235 (CONF-710501-P2, pp 1144-1149) DYNAMICS OF CONOTRACHELUS NENUPHAR (COLEOPTERA: CURCULIONINAE) POPULATIONS FOLLOWING EXPOSURE TO IONIZING RADIATION. Willard, W. K. (Clemson Univ., SC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The dynamics of plum curculio (Conotrachelus nenuphar Herbst.) populations were studied following exposure to a series of acute x-radiation doses (0, 1.0, 1.5, 2.0, 2.5, 3.0, 4.5, 6.0, and 9.0 kR). Generally, for a given treatment, mean life expectancy gradually decreased with increasing age. Mean life expectancy increased (but not significantly) with increasing dose up to a maximum of 4.44 months for males and 2.54 months for females and then decreased with each additional increment of dose. The death rate was higher for females than for males in nearly all treatments and age classes. Survivorship decreased rapidly following emergence as adults, and was greatest in the populations that had received 1.5 and 2.0 kR. Fecundity began slowly and was greatest when the adult beetles were 4 to 6 weeks of age, and then gradually declined with increasing age. The total number of larvae produced by treated populations was greatest in populations that had received 1.5 kR and was significantly reduced in populations receiving 2.5 kR and above. Examination of the growth rates, net reproductive ratios, cohort generation times, and doubling times showed that populations receiving 1.5 kR had a net reproductive rate nearly double that of the control group, but required 14% more time in which to accomplish this, even though the capacity for increase was slightly higher than the control. At doses above 1.5 kR, the net reproductive rate gradually decreased to zero, while the capacity for increase decreased to a minimum in populations receiving 3.0 kR. The capacity for increase (r_c) was equal to zero when the total radiation dose was 2650 R. (auth)

30236 (CONF-710501-P2, pp 1150-1157) GAMMA RADIATION PROFILES FOR THE MIGRATORY GRASSHOPPER MELANOPLUS SANGUINIPES (FAB.). Van Hook, R. I. Jr. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Egg, nymph, and adult instars of the migratory grasshopper, Melanoplus sanguinipes, were irradiated at nine different dose levels with ^{60}Co gamma radiation. Biological end points examined for assessment of radiation effects were egg hatch at 20 days post-irradiation, survival of nymphs hatched from irradiated eggs, and survival and longevity of irradiated nymphal and adult instars. The egg stage was the most radiosensitive, with an LD_{50-20} of 400 rads. For nymphs hatched from irradiated eggs, only those in >1000-rad treatments demonstrated immediate departure from survival patterns of control animals. Radiosensitivity decreased by a factor of 3 from eggs to nymphal stages. The LD_{50-10} values for first instar through adult grasshoppers were 2780, 2340, 4780, 1490, and 2280 rads, respectively. Radioresistance did not increase steadily with developmental stage. Mean life expectancies for each instar were significantly ($P \leq 0.05$) depressed by doses greater than 700 rads. Survival patterns of irradiated instars were similar; differences occurred mainly in postirradiation survival times. (auth)

30237 (CONF-710501-P2, pp 1158-1162) PRELIMINARY INVESTIGATION OF THE EFFECTS OF GAMMA IRRADIATION ON THE FERTILITY, SURVIVAL, AND MATING COMPETITIVENESS OF THE BEET ARMYWORM, SPODOPTERA EXIGUA (HUEBNER). Debolt, J. W. (Agricultural Research Service, Mesa, AZ). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The beet armyworm, Spodoptera exigua (Hubner), became increasingly resistant to the lethal and developmental effects of gamma irradiation as development progressed from eggs, larvae, and pupae to adults, and irradiation of any stage prior to the late pupal stage resulted in severe damage. A high degree of sterility was induced in the P_1 and F_1 generation moths without reduction in mating if the insects were irradiated after adults were fully formed in the pupal case or had emerged. Mating and longevity were not reduced when adults were exposed to the doses required to ... ieve 98.5% P_1 sterility. (auth)

30238 (CONF-710501-P2, pp 1163-1168) EFFECTS OF GAMMA RADIATION ON THE RESPIRATORY METABOLISM OF ADULT BEET ARMYWORMS, SPODOPTERA EXIGUA (HUEBNER) (LEPIDOPTERA: NOCTUIDAE). Hadley, N. F. (Arizona State Univ., Tempe). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The effects of gamma radiation on oxygen consumption were determined for adult beet armyworm moths, Spodoptera exigua (Hubner), which had received dosages necessary to induce male sterility (40 kilorads) or delayed sterility in their F_1 offspring (20 kilorads). These effects were further examined with respect to increased temperature, time of measurement following irradiation, and pupal versus adult irradiation. Results indicated that metabolic rates of both males and females showed little immediate (36-hr) effects from radiation exposure, even when dosages were increased to levels (120 kilorads) which caused neuromuscular damage. Significant increases or decreases in oxygen uptake of irradiated moths did not appear until approximately five days after exposure, and a pattern consistently differing from that of normal moths was not apparent. In spite of the high radiation dosages needed to induce sterility in this lepidopteran species, it does not appear that the physiological competitiveness of irradiated moths in terms of their respiratory metabolism is seriously affected. (auth)

30239 (CONF-710501-P2, pp 1174-1178) EFFECTS OF CHRONIC RADIATION EXPOSURE ON MOSQUITOES (DIPTERA: CULICIDAE). I. Effects of Rearing in $^{90}Sr + ^{90}Y$ Solutions. Guthrie, J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba); Brust, R. A. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Larvae of Aedes aegypti and A. atropalpus were reared in various concentrations of $^{90}Sr + ^{90}Y$ ranging from 0.1 to 20 μCi/ml. All these concentrations produced some effects. In many individuals the testes and ovaries of the adults were atrophied. In others, the production of viable sperm and their transfer to the spermathecae were affected, and the oocytes did not mature. Females that received viable sperm laid non-viable eggs. Irradiated females retained their mating competitiveness but did not take any blood-meals. Thus, their release with sterile males might increase the effectiveness of the sterile-male technique for mosquito control. (auth)

30240 (CONF-710501-P2, pp 1179-1190) BIOLOGICAL EFFECTS OF GAMMA RADIATION ON THE LIFE STAGES OF TWO FRUIT FLY SPECIES. Cavalloro, R.; Delrio, G. (Euratom Joint Nuclear Research Center, Ispra, Italy). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The biological effects of ionizing radiations on all the stages of the life cycle of two Diptera trypetidae, Dacus oleae Gmelin (olive fruit fly) and Ceratitis capitata Wiedemann (Mediterranean fruit fly), were determined and the results compared. For the eggs the LD_{95} for hatching was determined and found to be 850, 1540, and 49,000 rads for the olive fruit fly and 850, 1210, and 42,000 rads for the Mediterranean fruit fly, the eggs being irradiated at the age of $\frac{1}{2}$, 18, and 36 hr respectively. However, doses of more than 500, 1200, and 1500 rads prevent the development of adults of the three ages of the irradiated eggs. The LD_{95} for the emergence of adults of irradiated one-day-old and mature larvae was, respectively, 1860 and 2500 rads for the olive fruit fly and 1760 and 2360 rads for the Mediterranean fruit fly. Doses of over 20 kilorads given to young larvae and of over 150 kilorads to the mature larvae impeded pupation of the two species. Doses of less than 20 kilorads caused a delay in larval development in the young larvae, besides a decrease in the percentage of pupation. The doses necessary to prevent 95% adult emergence from three-day-old pupae or from mature pupae (three days before emergence of the adults) were 4500 and 72,500 rads for the olive fruit fly and 5600 and 64,000 rads for the Mediterranean fruit fly. The dose necessary to halve the ST_{50} of normal insects was found to be 40 kilorads, one-day-old adults of both species being irradiated. Sterilizing doses for the two sexes in the adult stage were 17 kilorads for the olive fruit fly and 13 kilorads for the Mediterranean fruit fly. For both species irradiated at the pupal stage (three days before adult emergence) the sterilizing dose was 10 kilorads, and the dose with which 98% sterility was obtained was 8 kilorads; at such doses the adults did not show any reduction in longevity as compared with the controls. Only 2 kilorads were necessary for sterilization when pupae three days old were irradiated; lower doses are sufficient to sterilize insects in other preimaginal stages. It was ascertained that D. oleae has a greater resistance to ionizing radiation than C. capitata. (auth)

30241 (CONF-710501-P2, pp 1191-1197) EFFECT OF GAMMA IRRADIATION ON THE REPRODUCTIVE PERFORMANCE OF ARTEMIA AS DETERMINED BY INDIVIDUAL PAIR MATINGS. Holton, R. L. (Atomic Energy Commission, Washington, DC); Osterberg, C. L.; Forster, W. O. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The brine shrimp, Artemia, was used as an experimental organism to study the effects of ^{60}Co gamma irradiation on the reproductive performance of an animal species. The total reproductive ability of the brine shrimp was fractionated into various components, and the effect of irradiation on each of these components was then determined by studies of reproductive behavior in individual pair matings. The components identified were the number of broods produced per pair, the number of nauplii voided per brood, the survival of nauplii to sexual maturity, the number of mature adults produced per brood, and finally the number of mature adults produced per pair. All component parameters of total reproductive performance were shown to be affected by irradiation within the range of doses used in this experiment. However, the number of broods per pair was shown to be the factor most sensitive to irradiation, with effects noted at doses of 900 rads and above. (auth)

30242 (CONF-710501-P2, pp 1198-1205) EFFECT OF GAMMA IRRADIATION ON THE MAINTENANCE OF POPULATION SIZE IN THE BRINE SHRIMP, ARTEMIA. Holton, R. L. (Atomic Energy Commission, Washington, DC); Osterberg, C. L.; Forster, W. O. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee USA (10 May 1971).

In radionuclides in ecosystems.

Population cultures of the brine shrimp, Artemia, were irradiated with acute doses of gamma irradiation from a ^{60}Co source. The subsequent reproductive performance and size of the cultures were studied for a period of 20 weeks. It was demonstrated that the population cultures may be maintained with only a small part of the reproductive potential exhibited in the pair matings. Therefore, we find that the results of pair matings must necessarily be used to assess the amount that the reproductive potential of Artemia is decreased due to various doses of irradiation. Population cultures at all doses were shown to have the same sized populations at the end of 20 weeks. However, it was demonstrated that the populations irradiated at higher doses had not recovered to their full reproductive potential at the end of this time. (auth)

30243 (CONF-710501-P2, pp 1206-1212) EFFECT OF IONIZING RADIATION ON THE BLOOD OF A MARINE POLYCHAETE WORM MARPHYSA MOSSAMBICA PETERS. Patel, S.; Patel, B. (Bhabha Atomic Research Centre, Bombay). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The effect of gamma irradiation on the spectral behavior of the extracellular hemoglobin of a marine polychaete worm Marphysa mossambica was studied. The radiation effects observed are further compared with the extracellular hemoglobins of false cockle Cardita antiquata and erythrocytic hemoglobin of ark-shell bivalves Anadara granosa and Scapharca deyrollei subsp. crispi, in terms of radiosensitivity of the pigments. (HLW)

30244 (CONF-710501-P2, pp 1213-1221) EFFECTS OF CONTINUOUS LOW LEVEL GAMMA RADIATION ON ESTUARINE MICROCOSMS. Williams, R. B.; Murdoch, M. B. (National Marine Fisheries Service, Beaufort, NC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Two types of marine communities, microcosms of water, sediment, algae, and invertebrates and fouling communities of sessile invertebrates in running seawater, were maintained for approximately one year exposed to various levels of gamma radiation. The radiation source was ^{60}Co; maximum dose rates were 2.1 to 3.3 rads/hr. At the end of the experiments no differences clearly correlated with radiation dose were detected between communities of either type. (auth)

30245 (CONF-710501-P2, pp 1222-1228) STRUCTURE AND FUNCTION OF HARDWOOD LITTER AND SOIL SUBSYSTEMS AFTER CHRONIC GAMMA IRRADIATION. I. Mesofauna, Nitrogen, and Total Soil Respiration. Coleman, D. C. (Univ. of Georgia, Athens); Cowley, G. T. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (19 May 1971).

In radionuclides in ecosystems.

Several enclosures of hardwood litter-soil received dosages of gamma radiation ranging from 3600 to 4 kR. Some plots had reduced microflora and -fauna, others were low in fauna only, and the least dosed had no significant changes in numbers. Only the most heavily irradiated enclosure was significantly below the controls in CO_2 output, indicating that microflora are more important contributors to overall CO_2 output than are mesofauna. Temperature was a more important factor than soil moisture in governing soil respiration. (auth)

30246 (COO-2001-9) GENETIC EFFECTS OF LOW X-RAY DOSES IN DROSOPHILA. Progress Report, July 16, 1972–August 15, 1973. Abrahamson, S.; Meyer, H. U. (Wisconsin Univ., Madison). 1973. Contract AT(11-1)-2001. 12p. Dep. NTIS $3.00.

Results are reported from investigations of the relationship of x ray dose to frequency of new sex-linked lethals for oogonia of Drosophila treated with low doses. The relation of sex-linked lethal frequencies induced by doses of 20, 100, 200 and 500 R in immature, metabolizing germ cells to the expected values obtained by extrapolation from high dose results on a linear model was investigated. Only the results from 500 R exposure differed significantly from the control rate. (CH)

30247 (FRNC-R-19, pp 132-134) AMINO-ACIDEMIA AND WHOLE BODY IRRADIATION OF SCORPIONS. Goyffon, M. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (in French).

Investigations were undertaken in order to discover whether radioresistant animals such as the scorpion release taurine by cellular lysis after whole-body irradiation. Measurements were made on the hemolymph. An attempt was also made to determine the content of other amino acids. It was observed that the taurine level of irradiated scorpions dropped. This behavior contrasts with that observed in mammals. A very significant increase in al anine was also observed. Taurine behaves as a radio-repairing, rather than a radioprotecting, substance. (FR)

30248 (IAEA-R-959-F) STERILIZATION OF ADULT RICE STEM BORERS, CHILE SUPPRESSALIS. Part of a Coordinated Programme on the Control and/or Eradication of Rice Insect Pests. Final report, 15 January 1971–14 January 1972. Chiang, J. J. (International Atomic Energy Agency, Vienna (Austria)). Feb 1972. 23p. INIS.

In sterilization of the adult by irradiation, the important function is to obtain a genetic dominant lethal mutation, and the dominant lethal mutation is calculated from the number of eggs fertilized by sperm. In order to control the sterile situation so that newly formed chromosomes with mutants could be identified, the germ cells of rice stem borer were treated by irradiation in the period before chromatid duplication. This enabled the mutant to be sequestered within the original germ cells and the mortality of F_1 larvae to be determined. (INIS)

30249 NATURAL AGING AND RADIATION-INDUCED LIFE SHORTENING IN DROSOPHILA MELANOGASTER. Miquel, J.; Bensch, K. G.; Philpott, D. E.; Atlan, H. (Ames Research Center, Moffett Field, CA). Mech. Ageing Develop.; 1: No. 1, 71-97(1972).

Various tissues of control and γ-irradiated male Drosophila melanogaster were investigated by light and electron microscopy. Old flies showed involutionary changes in the fat body, oenocytes, muscle, mid-gut, Malpighian tubules, brain, and sex organs. There was an accumulation of electron-dense bodies in the oenocytes and of ceroid-like material in the cytoplasm of the mid-gut cells. Also, senescent flies showed a striking reduction in the ribosomes and endoplasmic reticulum in the Malpighian tubules. In 28 to 33-day-old flies that were exposed to 50 kR of γ irradiation at 1 day of age, the most consistent pathological changes were focal cytoplasmic edema and virus accumulation in the nuclei. The present results support the view that irradiation results in life-shortening through a radiation syndrome mechanism that is essentially unrelated to aging. (auth)

30250 DISTRIBUTION ALONG X-CHROMOSOME OF RECESSIVE LETHALS INDUCED BY DIRECT AND INDIRECT X-RADIATION EFFECT IN DROSOPHILA. Ondrej, M. (Inst. of Experimental Botany, Prague). Folia Biol. (Prague); 19: No. 4, 301-304(1973).

Males of Drosophila melanogaster were x-irradiated and mated to nonirradiated females. Besides recessive lethals induced directly in the irradiated chromosomes of the spermatozoa, recessive lethals were induced also indirectly in oocyte X chromosomes. Recessive lethals induced on these two principles were localized and their distribution was compared. The results are discussed in respect to a possible mechanism of indirectly induced mutations in the X chromosome of nonirradiated females. (auth)

30251 LONG-TERM EFFECTS OF IONIZING RADIATION ON DROSOPHILA MIDGUT MITOCHONDRIA. Gartner, L. P. (Univ. of Maryland, Baltimore). Strahlentherapie; 145: No. 6, 725-730 (1973).

Wild type flies of the Canton-S strain of D. melanogaster aged one to three days, were exposed to ^{60}Co γ rays at a dose rate of 25 R/min for a total dose of 99 kR. Control animals were treated in an identical manner, but were shielded from the γ rays by a concrete wall supplemented by lead bricks. The irradiated and control populations were randomly subdivided into 2 groups, one for determination of life span, and the other for ultrastructural examinations of the cells of the midgut at predetermined intervals. The exposure to 99 kR did not only completely sterilize the flies, but also drastically reduced their life span. Time-related ultrastructural changes were noted in the midgut mitrochondria. These alterations included a gradual swelling of the organelles as well as the disarrangement of the ordered configurations of the cristae mitochondriales. A theory of mitochondrial swelling, based on impaired membrane permeability, was suggested. (GE)

30252 RESPONSES OF A GRASSLAND ARTHROPOD COMMUNITY TO SIMULATED RADIOACTIVE FALLOUT. Styron, C. E.; Dodson, G. J. (Oak Ridge National Lab., TN). Radiat. Res.; 55: No. 3, 487-500(Sep 1973).

Responses of an arthropod community to beta and gamma radiation from ^{137}Cs-tagged simulated fallout and the interaction of radiation with other environment parameters are being investigated in a unique experimental facility at Oak Ridge National Laboratory. Lithium fluoride microdosimeters attached to the thorax and abdomen of insects in a fallout field indicate that closely related organisms may receive significantly different doses owing to differences in habitat or behavior. Significant differences in variation between control and contaminated communities appeared in summer 1970 ($P \leq 0.05$), disappeared in autumn 1970, and reappeared in summer 1971 ($P \leq 0.01$). Population densities of four arthropod taxa had been significantly ($P \leq 0.05$) reduced by summer 1970. By summer 1971, three of these taxa had recovered to control levels, but four additional taxa underwent significant ($P \leq 0.05$) reductions in population density. This number of affected populations is not statistically significant. No significant increase in dissimilarity in taxa composition between the contaminated and control areas was evident. Consequently, the threshold for long-term effects of fallout radiation on taxa comprising the arthropod community appears to be above the 2.4 to 13.0 rads/day exposure over the 3-year period. (auth)

30253 MACROMOLECULAR SYNTHESIS AND CELL DIVISION IN X-IRRADIATED TETRAHYMENA. Paul, I. J.; Zimmerman, A. M. (Univ. of Toronto). Radiat. Res.; 55: No. 3, 411-421(Sep 1973).

The sensitivity of heat-synchronized Tetrahymena pyriformis to x radiation was dependent on the magnitude of the radiation dose and the age of the cell population. Division delays of increasing duration were exhibited by cells irradiated with progressively greater doses of x radiation at a specific time during the cell cycle. Moreover, division delays of increasing duration were produced when cells were irradiated with a specific dose at progressively later times during the cell cycle. The precise time of transition from radiation sensitivity to radiation insensitivity was found to be dose dependent. Studies involving the addition of either actinomycin D or puromycin to cells at various times after irradiation indicated that both RNA and protein synthesis were required for the recovery of Tetrahymena from the radiation effects; cell division was employed as an index for recovery from radiation damage. DNA, RNA, and protein synthesis in irradiated cells were all differentially depressed. These results are discussed in terms of their relationship to the radio-induced delay of cell division. (auth)

30254 INVESTIGATIONS ON RADIOSENSITIVE AND RADIORESISTANT POPULATIONS OF DROSOPHILA MELANOGASTER. III. Persistence of the Lower Radiosensitivity in Stage-7 Oocytes of RÖ I Females after Treatment with Oxygen and Nitrogen Pre- and Post-irradiation. Noethel, H. (Leiden Univ., Netherlands). Mutat. Res.; 19: No. 2, 187-197(Aug 1973).

The effects of oxygen and nitrogen pre- and post-treatments on the radiosensitivities of an irradiated (RÖ I) and a control (+) population of Drosophila melanogaster were tested. Before the commencement of the present studies RÖ I had been exposed to 2100 R of x rays each generation for over 240 generations. In earlier tests, stage-7 oocytes of RÖ I exhibited a markedly decreased radiosensitivity after exposure in air. Results are presented on the induction of dominant lethals and X-chromosome loss in stage-7 oocytes at various exposure levels of x-irradiation. They demonstrate that the absolute radiosensitivity of both populations is subject to predictable changes depending on the combinations of gas-treatments. The relative difference in radiosensitivity between + and RÖ I, however, persists at any treatment combination. It is concluded that the stage-7 oocytes of the two populations do not differ with respect to oxygen-dependent radiosensitivity, oxygen content, or oxygen-dependent repair of radiation damage. (auth)

30255 RADIATION STERILIZATION OF AEDES AEGYPTI IN NITROGEN AND IMPLICATIONS FOR STERILE MALE TECHNIQUE. Hallinan, E.; Rai, K. S. (Notre Dame Univ., IN). Nature (London); 244: No. 5415, 368-369(10 Aug 1973).

A problem that arises with mosquitoes and other insects when the irradiation induced sterile male technique is employed is that the sterilized males cannot compete with untreated native males for mating with females; the irradiation impairs vigor. The effects of irradiation on living organisms, however, may be modified by changing the internal environment of the irradiation cell, and it was found that an improved competitiveness resulted when irradiation was conducted in the absence of oxygen. With nitrogen, the males lived longer than with an air environment and competed successfully for females. Some studies are described on nitrogen irradiation of Aedes aegypti. Male pupae and one-day-old adults were irradiated at 3500, 7000, and 10,000 R γ radiation in flowing nitrogen, and their competitive mating ability tested against untreated males. Lack of hatchability was used as an indicator of whether a female was inseminated by a sterile male. The data indicated that males irradiated to 7000 to 10,000 R in the presence of nitrogen were as competitive as normal males in mating with females, and the results indicate that nitrogen may protect irradiation sterilized males sufficiently to permit the sterile male technique to be effective in the control of this and other insect species. (UK)

30256 RADIATION-ATTENUATED HELMINTH VACCINES. Laboratory Studies on the Production and Evaluation of Gamma-Irradiated Vaccine Against the Sheep Lungworm, Dictyocaulus Filaria. Tewari, H. C.; Gangadhararao, Y. V. B.; Dhar, D. N. (Indian Veterinary Research Inst., Izatnagar, India). Indian J. Anim. Sci.; 42: No. 1, 32-37(1972).

Laboratory experiments were conducted in lambs, 4 to 6 months of age, to determine the resistance produced as a result of double vaccination with the irradiated D. filaria larvae. Three groups of lambs were used. Group I was given the first vaccine dose of 1,000 larvae irradiated at 45 kR, followed by a second vaccine dose of 2,000 larvae irradiated at 45 kR after 28 days. Animals in group II

were similarly vaccinated with larvae irradiated at 50 kR. The animals in the vaccinated and the unvaccinated control group were challenged on 42nd day with 5,000 normal unirradiated larvae. All the surviving animals were killed on 84th day for detailed parasitological and pathological examinations. It was concluded that a significant protection was conferred on lambs following vaccination with a double dose of irradiated larvae. (Indian Sci. Abstr.)

30257 MAJOR AND TRACE ELEMENTS AS BIOINDICATORS OF ACUTE INSECT RADIOSENSITIVITY. Levy, R.; Cromroy, H. L.; Cornell, J. A. (Univ. of Florida, Gainesville). Radiat. Res.; 56: No. 1, 130-139(Oct 1973).

Simple regression analyses of 20 species of insects representing the orders Anoplura, Coleoptera, Diptera, Hemiptera, Hymenoptera, Orthoptera, and Thysanura indicated that the total body concentration of several major and trace elements could be used as bioindicators or biopredictors of acute ($LD_{50(24\ hr)}$) radiosensitivity for a species population when insects were subdivided into groups based on laboratory diets. The groups were divided into cockroaches, blood feeders, and stored product beetles based on their broad dietary. Statistical models based on insect total body potassium, magnesium, and copper (i.e., copper/iron ratio) for the 3 groups, respectively, were found to be effective in predicting or estimating acute radiation mortality for related insect species having similar feeding preferences. (auth)

Radionuclide Effects (Internal Source)

Refer also to abstract 31728.

Man

Refer also to abstracts 29861, 30093, and 30294.

30258 (AD-761638) INHALATION OF RADIOIODINE FROM FALLOUT: HAZARDS AND COUNTERMEASURES. Final Report. Cole, R. (Environmental Science Associates, Burlingame, Calif.). Aug 1972. Contract DAHC20-70-C-0381. 308p. (ESA-TR-72-1). NTIS.

The late development of severe damage to the thyroid in most of the Marshallese children in the group on Rongelap Atoll most heavily exposed to fallout from the 1954 CASTLE BRAVO nuclear test has raised questions about the importance of radioiodine intake in the civil-defense context. As a first step in investigation of this problem, an evaluation was made of the nature and extent of the intake of ^{131}I by inhabitants of the Marshall Islands, with emphasis on the possibility that inhalation was a major route of entry. Then, on the basis of the literature on fallout phenomenology, an estimate of the extent and rate of volatilization of iodine from siliceous fallout particles was made. It was found that under certain circumstances significant thyroid doses could be the result of inhalation intake and that the use of blocking iodide as a countermeasure was indicated. The effectiveness and the possible side effects of blocking iodide are discussed, and recommendations for administration are made, together with cost estimates. (auth)

30259 EFFECT OF RADON INHALATION ON THE REACTIVITY OF LYMPHOCYTES. Wiktor, Z.; Szewczyk, Z. (Medical Academy, Wroclaw). Pol. Med. J.; 11: No. 6, 1371-1377(1972).

The effect of radon inhalation on blastic transformation of PHA-stimulated lymphocytes in vitro was studied. The material included patients with the following diseases: nephrotic syndrome, chronic glomerulonephritis, chronic renal failure, and healthy subjects. Following 30 min inhalation, no statistically significant stimulation or inhibition of lymphocyte blastic transformation was noted. After 20 radon inhalations a statistically significant decrease in blastic transformation in all groups except that with chronic renal failure was observed. In the group with chronic renal failure an increase in blastic transformation after a single and after 20 radon inhalations was noted. These results indicate a biological effect of radon on immunologically competent lymphocytes. (auth)

30260 RADIOLOGICAL HAZARDS ASSOCIATED WITH INTERNAL CONTAMINATION OF THE BODY BY RADIONUCLIDES. Marley, W. G. (National Radiological Protection Board, Harwell, Eng.). pp 21-29 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Current evaluations of the hazards from external radiation and internal radioactivity are summarized. Human experience with radium still provides a sound basis for fixing permissible levels for bone-seeking nuclides, but the importance is stressed of identifying the precise tissues at risk and determining the dose in those tissues from the various bone-seeking nuclides from their detailed metabolism. Tissue doses in fallout studies show that potential hazard from ^{137}Cs is some 7 to 15 times greater than from ^{90}Sr. Fallout studies have provided the basis for greatly improved knowledge of the metabolism in humans and the agricultural behavior of strontium and now enable the dose commitment to persons of all ages to be reliably calculated. This information is especially valuable in regard to the protection of the public in the event of accidents to nuclear reactors and also shows that the potential hazards from ^{90}Sr are now found to be much less than was hitherto thought. (auth)

30261 MATHEMATICAL PROCEDURES FOR ESTIMATING DOSE FROM AN INTERNALLY DEPOSITED EMITTER. Snyder, W. S. (Oak Ridge National Lab., TN). pp 33-48 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The estimate of dose delivered by a radionuclide will depend on its decay scheme and the related dosimetry data available, on its distribution and retention in the body, and on the characteristics of the individual who incorporates the activity. Dillman and Blichert-Toft have provided decay scheme data for most radionuclides, and Spiers has greatly advanced our knowledge of the dose to red bone marrow and to endosteal cells. The new point kernel of Berger offers the possibility of better dosimetry for beta-like radiation. Finally, the methods presented in Mird Pamphlet Nos. 3, 5, and 8 have made it possible to take account of dose delivered by sources of photons anywhere within the body. The impact of the new ICRP lung model and of identification of endosteal cells as the sensitive cells of bone demands more detailed information on retention and distribution of a radionuclide and its daughters if the corresponding doses are to be computed. The model of Marshall for the metabolism of the alkaline earths is a first step in this direction, providing estimates of the material present in trabecular and cortical bone. Finally, attention is being given to the importance of individual characteristics (of fetus, infant, child, adult), both as regards uptake and retention, Lloyd et al., Nature 220, (1968 1029), and with respect to dosimetry (W. S. Snyder, ORNL-4720), although there is an abundance of problems centering about the fetus and younger age groups that will challenge our ingenuity in the future. (auth)

30262 CALCULATION AND MEASUREMENT OF ORGAN DOSES DUE TO INTERNAL GAMMA EMITTERS. Feher, I.; Koblinger, L.; Szabo, P. P. (Central Research Inst. for Physics, Budapest). pp 49-54 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Several papers have been published on the absorbed energy fractions in different organs due to internal sources, but until now these fractions have not been verified with experiments. In this paper Monte Carlo calculations and measurements using the well-known BOMAB phantom are described for the theoretical and experimental determination of the dose absorbed in the lungs. Special lungs were formed to contain the dosimeter, and the sites of the thyroid and testicles were specified. The ^{60}Co and ^{131}I sources were deposited in both these latter organs. To measure the dose, LiF TL powder was suspended in an organic vehicle and this paste was taken into the lungs. The absorbed energy fractions measured by this method of physical integration and the fractions computed by a Monte Carlo code are in agreement. The calculated values are also close to those calculated for the inhomogeneous SNYDER phantom. The experimental method described in this paper can also be applied in the case of small targets and anatomically correct organs, where calculations cannot give accurate results. (auth)

30263 LOCAL AND AVERAGE DOSES IN BONES CONTAMINATED BY BETA-EMITTERS. Schaeffer, R. (Electricite de France, Paris). pp 55-64 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Contamination by ingestion of strontium is used as an example. The bone turnover involves the formation of hot spots, whose specific activity can be calculated by means of the observed ratio. Taking into consideration the range of beta rays, the local dose absorbed in hot spots must be calculated by multiplying this specific activity by the fraction of the total bone volume that they occupy. But this correction is still not sufficient because it does not take into account the activity brought on by the diffusion process. The method of calculating the average dose with the help of

retention functions applicable to the entire skeleton takes into account the two biological phenomena and therefore appears to be the best approach. (auth)

30264 SOME ASPECTS OF A SAMPLING PROGRAM AND OF THE DOSIMETRIC INTERPRETATION OF INCORPORATION MEASUREMENTS. Klucke, H. (National Centre for Radiation Protection, Berlin). pp 83-85 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Some aspects of a so-called sampling program for the control of all persons in the GDR which are working with open radioactive materials are presented. The calculations of the parameters of our program are based on the assessment of the internal dose under consideration of the metabolic behavior of the nuclides and of the exact data of each working place. (auth)

30265 ESTIMATES OF ABSORBED FRACTION FOR PHOTON EMITTERS WITHIN THE BODY. Snyder, W. S.; Ford, M. R.; Warner, G. G. (Oak Ridge National Lab., TN). pp 87-94 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Estimates of absorbed fractions of energy from monoenergetic sources of photons in organs of the body have been published for organs which have approximately the correct shape, size, location in the body, density, and composition, but only results with coefficient of variation less than 50% were reported. A method of filling this gap is the subject of this paper. The specific absorbed fraction of energy may be computed by use of the build-up factor for an infinite homogeneous medium of tissue, and the results agree with those obtained previously to within a factor of 2 or less. It is suggested that an estimate based on this formula be used when the coefficient of variation of the published estimate is more than 25%. The build-up factor is taken from MIRD Pamphlet No. 2 by M. Berger and from unpublished results of his work kindly supplied to the authors. When the Monte Carlo results are statistically reliable, the difference is generally much less than a factor of 2, and this suffices to establish the fact that the use of the build-up factor for an infinite medium does not involve a large discrepancy. The integration of the above formula is done by a Monte Carlo technique, and these estimates are being readied for publication. (auth)

30266 CALCULATION OF THE RADIATION DOSE FROM MEASUREMENT OF RADIONUCLIDES IN THE BODY OF ITS EXCRETA. Strauss, H. (National Centre for Radiation Protection, Berlin). pp 101-105 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The pattern of intake as a function of time is usually unknown. Therefore an approximation method must be applied for the calculation of the radiation dose from measurements of radionuclides in the body or its excreta. This method is based on the assumption that the total uptake took place at the midpoint of the probable time interval of intake. According to this method the greatest deviation of the approximated value of the internal dose given by this method is represented and discussed as a function of the quotient of the time interval of intake and the effective half-life of the radionuclide in the compartment. (auth)

30267 PROBLEMS CONCERNING THE RECOMMENDATION OF A MAXIMUM PERMISSIBLE INHALATION INTAKE OF SHORT-LIVED RADON DAUGHTERS. Jacobi, W. (Hahn-Meitner-Inst. for Nuclear Research GmbH, Berlin). pp 109-120 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The applicability of the risk concept for the evaluation of a maximum permissible annual exposure (MPAE) to short-lived ^{222}Rn-daughters in air is discussed on the basis of available data about lung cancer mortality among uranium miners. By comparison with other occupational risks and the background level of these nuclides in normal air, a MPAE in the range of 2.5 to 5 WLM is derived that corresponds to a Rn-activity concentration of 20 to 40 pCi/liter in radioactive equilibrium with its daughters. Finally the relation between exposure and lung dose is discussed with respect to the importance of uncombined daughter atoms and the influence of ventilation. (auth)

30268 SOME PROBLEMS OF MAXIMUM PERMISSIBLE DOSES BY INHALATION OF SHORT-LIVED ^{222}Rn-DAUGHTERS IN MINES AND RADON SPAS. Uzunov, I. (Univ., Sofia). pp 121-124 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Measurements in the range of the present MPC are discussed. It seems that MPD and/or MPC cannot be reasonably defined with regard to the radiation factor alone. The effect of nonspecific proliferative stimuli is pointed out. A world-wide epidemiologic study in Rn-spas is desirable in order to assess the clean effect of Rn-daughters on the human lung. (auth)

30269 DEPENDENCE BETWEEN INTERNAL DOSE DUE TO THE INHALATION OF ^{222}Rn AND ITS DAUGHTERS, AND CHROMOSOMAL ABERRATIONS IN PERIPHERAL BLOOD LYMPHOCYTES. Pohl Rueling, J. (Research Inst. Gastein, Badgastein, Austria); Fischer, P.; Pohl, E. pp 125-128 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The population of the Austrian spa Badgastein is living and working within an elevated natural radioactivity. Their thoroughly assessed environmental radiation burden caused mainly by inhalation of radon and daughters is associated with an in vivo investigation of chromosomes in peripheral blood lymphocytes. An increase of the aberrations starts at alpha blood doses somewhere between 0.3 and 1 rem/a, and is certainly significant at about 5 rem/a. (auth)

30270 LUNG CANCER RISK IN RELATION TO LONG-TERM EXPOSURE TO RADON DAUGHTERS. Sevc, J. (Inst. of Hygiene and Epidemiology, Prague); Placek pp 129-136 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The first results of an epidemiological study carried out in a large group of uranium miners are shown. The highest lung cancer mortality was observed in the interval of 15 to 17 yrs since the onset of exposure to radon daughters. When the exposure exceeded 100 WLM, the observed mortality was 2 to 6 times higher than was expected. A linear relationship was found between the mortality rate of additional lung cancer cases and the estimated cumulative exposure. (auth)

30271 SCIENTIFIC BASIS FOR RADIATION PROTECTION GUIDANCE FOR UNDERGROUND URANIUM MINERS IN THE UNITED STATES. Wolff, A. H. (Univ. of Illinois, Chicago). pp 137-143 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The use of the Working Level Month (WLM) as a radiation exposure unit for uranium mining standards in the U.S. is discussed. The relationships of the WLM unit to lung tissue dose and cancer induction and to the ICRP/NCRP recommendations for occupational radiation protection are also discussed. Recently the guidance for the radiation protection of underground uranium miners in the U.S. was lowered from 12 to 4 WLM per year. This action was based on radiobiologic and epidemiologic evidence that indicates that the lung is a relatively sensitive organ with respect to the radiation induced cancer. The principal epidemiologic information leading to the revised standard came from a study of about 3,400 uranium miners in the U.S. In this study inhalation exposure to radon daughters down to at least 120 to 359 cumulative WLM was shown to be the major causal factor for a high incidence of respiratory cancer among uranium miners. (auth)

30272 ASSESSMENT OF RADIATION SAFETY AND EFFICIENCY OF PROPHYLACTIC MEASURES IN NATURAL URANIUM OPERATION. Andreeva, O. S.; Yegorova, M. S.; Parkhomenko, G. M. (Inst. of Biophysics, Moscow). pp 145-147 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Working with uranium, the personnel are exposed to complex effects of various radiation factors. The greatest potential hazard is associated with the inhalation of uranium aerosols possessing radioactive and toxic properties. Therefore, the effective air protection in the working premises from penetrating aerosols and the maintenance of radiation parameters at the levels not exceeding the average annual permissible concentrations are very important. It is of much significance to control the uranium aerosol concentrations and to estimate the uranium content in the body and critical organs. The workers are exposed to external gamma- and beta-radiation. Radiation exposure levels vary signifi-

cantly and are determined by the shift rate in radioactivity equilibrium between uranium and its daughter products UX_I (^{234}Th), UX_{II} (^{234}Pa). (auth)

30273 PERSONNEL MONITORING OF RESPIRATORY TRACT OVERIRRADATION HAZARD DUE TO Rn DECAY PRODUCTS. Parfyonov, V. A.; Ryabov, N. V.; Stas, K. N. (Union Research Inst. of Instrumentation, Moscow). pp 149-152 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The known personnel monitoring techniques of radon short-lived decay products are reviewed. Their advantages and shortcomings are studied. Aspects of further development of monitoring apparatu are discussed. (auth)

30274 ESTIMATION OF THE ABSORBED DOSE IN PATIENTS FROM IMPURITIES IN GENERATOR PRODUCED RADIONUCLIDES. Colombetti, L. G. (Loyola Univ., Chicago); Husak, V. pp 155-159 of Health Physics Problems of Internal Contamination. Bujdoso, E (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A method is presented for the estimation of the contribution to patient radiation dose from the radioactive impurities in eluates from generators. The proposed equations involve the dose equivalent per unit of activity, the fraction of the radionuclidic impurity contained in the principal radionuclidic activity and the time lag between milking and administration of the radiopharmaceutical to the patient. An example of the values of dose equivalents for some impurities occurring in eluates of ^{99m}Tc is presented. (auth)

30275 ESTIMATION OF PERMISSIBLE RADIATION DOSES FROM ^{131}I, ^{90}Sr, HTO, AND ^{241}Am TO THE GONADS. Lyaginskaya, A. M. (Inst. of Biophysics, Moscow). pp 181-184 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Estimating the risk from various radioactive substances to the gonads, the most important is the radiation dose incorporated directly by the gonads. Contribution of direct irradiation and indirect effect will be different. When radioactive substances with uniform distribution type and high ionization density are incorporated into the body, the reaction of the gonads is mainly determined by their direct radiation exposure. In this case the effect to these organs will be more pronounced than that from radionuclides with selective accumulation (except the gonads). (auth)

30276 COMPARATIVE CLINICAL STUDIES ON THE OCCUPATIONAL HAZARDS FROM INHALED RADON DAUGHTERS IN WORKERS OF NON-URANIUM MINES AND MINERAL BATHS. Vaskov, L. S. (Joint Research Inst. of Hygiene and Labor Safety, Sofia). pp 645-650 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Clinical, laboratory, functional respiratory, and sputum cytological studies in 584 workers of non-uranium metal mines and 234 workers in mineral baths with similar atmospheric concentration of radon daughters were reported. No significant radiation alterations in the radon workers were found, except a tendency to increase the percentage of "atypical" cells in sputum. Further international studies at different levels of "pure" radon daughters exposures are necessary in order to find more exactly the dose-effect relationships. (auth)

30277 INTERNAL RADIATION EXPOSURE BY ^{232}Th AND ^{228}Th. Kaul, A. (Freie Univ., Berlin); Stahlhofen, W. (1973). vp. (In German).

From symposium on the natural radiation exposure of man: basis for judging the radiation risk; Frankfurt am Main, Germany (18 Jul 1973).

By the evaluation of various sources, the natural internal radiation dose of a 40-year old normal person due to ^{232}Th as well as ^{228}Ra in equilibrium with ^{228}Th and its metabolons was determined. Thus the total radiation dose in the Haversian system resulting from the decay of ^{232}Th and ^{228}Ra and its metabolons was between 0.63 and 1.04 mrd/year, in the limiting marrow layers in bones, between 0.24 and 0.41 mrd/year. The radiation dose of the soft tissue and the gonads was 0.034 mrd/year. The natural ^{232}Th content in bone contributed 2.5% to the total dose. The soft tissue share of the radiation dose by ^{232}Th was 10% of the total dose. (GE)

30278 INTERNAL RADIATION EXPOSURE BY ^{40}K. Kaul, A. (Freie Univ., Berlin); Roedler, H. D.; Oberhausen, E.; Werner, E. (1973). vp. (In German).

From symposium on the natural radiation exposure of man: basis for judging the radiation risk; Frankfurt am Main, Germany (18 Jul 1973).

The radiation exposure of the individual organs of man caused by the isotope mixture of natural potassium containing ^{40}K was determined. In calculating the radiation dose by ^{40}K, one must distinguish between a non-penetrating and a penetrating component of radiation due to the emission of electrons and γ quanta. The radiation dose caused by electrons in an organ, only depends on the ^{40}K concentration in that particular organ, however for the radiation dose due to γ quanta, one must also take the ^{40}K concentration of the neighboring organs into account. Several dose concepts were developed for calculating the absorbed radiation energy due to γ radiation. Its share of the total dose is about 12%. Red bone marrow has the highest total dose (some 30 mrad/year) and yellow bone marrow has a total of 5 mrad/year. The average value of the radiation exposure in the remaining organs is 14 mrad/year (11.0 to 20.1). (GE)

Animals

Refer also to abstracts 30185, 30348, and 30350.

30279 IRRADIATION DOSES DUE TO TRITIATED PHARMACOLOGICAL SUBSTANCES. Koch, G. F. (CEN, Mol, Belgium); Delwaide, P. A.; Dulcino, J. L. pp 171-174 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Evaluation, as a function of time, of the radioactivity present in several organs and subcellular fractions is studied in the mice after administration of tritiated organic drugs. Critical organs are liver and kidneys, nuclear fraction of these organs receiving not a higher irradiation dose than the average cell dose. Doses are lower than in the case of the incorporation of the same activity under the form of tritiated water. Results are discussed from a pharmacological and health physics point of view. (auth)

30280 SOME IMPORTANT PROBLEMS OF BIOLOGICAL ACTION OF TRANSURANIUM ELEMENTS. Moskalev, Y. I. (Inst. of Biophysics, Moscow). pp 187-195 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Results obtained in the course of investigations by Soviet scientists on the problems of biological action of ^{239}Pu and other transuranium elements are presented. Biological action of various compounds of these radionuclides is considered as a function of the dose and route of intake into the body, including inhalation, intravenous and intraperitoneal administration of the isotopes. Special attention is given to the analysis of late effects developing in the body as a result of injury by ^{239}Pu, ^{241}Am, and ^{237}Np, dose-effect curves for bone and lung tumors, estimation of minimum carcinogenic dose levels, and doses not affecting the natural life span. (auth)

30281 LATE EFFECTS INDUCED BY ^{226}Ra IN MICE. Klener, V.; Kofranek, V.; Onyskowova, Z.; Holusa, R.; Svoboda, V. (Inst. of Hygiene and Epidemiology, Prague). pp 227-230 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

See CONF-720503.

In a long-term study, the survival and the incidence of malignant disorders were investigated in mice administered with ^{226}Ra. The life-span was considerably shortened with 75 μCi ^{226}Ra/kg. After 20 μCi/kg and 8.2 μCi/kg the induction of osteosarcomas was observed, while the incidence of leukemia decreased. (auth)

30282 ORGANIC BOUND TRITIUM AS AN INCREASING TISSUE-DOSE AFTER SINGLE OR DAILY ADMINISTRATION OF TRITIATED WATER. Ciubotaru-Bordeianu, A.; Racoveanu, N.; Nigrium-Mihaescu, M.; Andreuta, I. (Inst. of Hygiene and Public Health, Bucharest). pp 269-274 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Serum-protein-bound tritium (T) was determined after single (intraperitoneal) or repeated (21 days gavage) administration of HTO. The results demonstrated that, in the case of single administration (75 μCi/g body weight), there is an increase from 0.1% in the first day to 0.8% in the 28th day in the percentage of the serum-protein-bound T as compared to the activity per g of body weight. In the case of repeated administration (3 μCi/g body weight/

day for 21 days) there is an increase in this percentage from 0.23 in the 3rd day to 2.5 in the 21st day after the last administration. T activity in the organs (bone marrow, spleen and serum) at various intervals after administration reveals the existence of biological half-times (T_B) of 2.2, 4.2, 12.6, and 57 days corresponding to the various metabolic compartments of T. (auth)

30283 ALTERATIONS OF THYROID MORPHOLOGY IN MICE BY RADIOACTIVE PHOSPHORUS—EFFECTS OF LARGE DOSES. Dev, P. K.; Srivastava, P. N. (Univ. of Rajasthan, Jaipur, India). Strahlentherapie; 145: No. 6, 674-679(1973).

Thyroid histopathology was studied after the administration of a high dose of radiophosphorus. Adult Swiss albino mice were injected with P-32 at the dose of 5 μCi/g body weight. The animals were sacrificed at intervals of 1, 3, 7, 15, and 30 days after the injection. The thyroid gland shows early damage in the form of colloid-like material staining in the lumen of the blood vessels. The epithelium was columnar in shape 3 days after the injection. Gradual loss of colloid from the follicles was evident with the onset of damage. At the later intervals, marked effects were noticed in the nuclei and vascular structure. No sign of recovery could be seen till the last interval. (auth)

30284 EFFECTS OF INHALED ^{90}Y FUSED CLAY AEROSOL ON PULMONARY FUNCTION AND RELATED PARAMETERS OF THE BEAGLE DOG. Mauderly, J. L.; Pickrell, J. A.; Hobbs, C. H.; Benjamin, S. A.; Hahn, F. F.; Jones, R. K.; Barnes, J. E. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Contract AT(29-2)-1013. Radiat. Res.; 56: No. 1, 83-96(Oct 1973).

Nine beagle dogs were exposed to aerosols of ^{90}Y in fused clay and examined serially using pulmonary function, clinical, and radiographic evaluations to better describe the pathogenesis of pulmonary damage resulting from the inhalation of beta-emitting radionuclides. The inhalation exposure resulted in initial lung burdens (ILB) of 390 to 920 μCi ^{90}Y/kg body weight and cumulative doses to the lung of 4900 to 12,000 rads. The evaluation of pulmonary function included measurements of ventilation, lung mechanics, gas exchange, and parameters obtained under the stresses of treadmill exercise and added external respiratory dead space. Functional alterations appeared in all exposed dogs at approximately 8 wk postinhalation exposure and the severity and rapidity of progression of dysfunction was related to dose. Early functional impairments included defects in the distribution of ventilation and in alveolar-capillary gas exchange. Later, tissue alterations increased the energy cost of breathing and created a major disturbance in the matching of ventilation and perfusion. Dogs receiving an ILB of approximately 400 μCi/kg demonstrated an early, transient, subclinical functional impairment that subsequently either resolved or failed to progress. Both treadmill and dead space testing were found useful in detecting subclinical and subradiographic lung damage. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 29846, 29866. 30266, 30268, and 30386.

30285 (CONF-710501-P2, pp 877-893) SYSTEMS ANALYSIS METHODOLOGY FOR PREDICTING DOSE TO MAN FROM A RADIOACTIVELY CONTAMINATED TERRESTRIAL ENVIRONMENT. Booth, R. S.; Kaye, S. V.; Rohwer, P. S. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

A systems analysis methodology was developed to predict intakes by man, estimate dose commitments, and identify critical exposure pathways resulting from radioactivity releases to a terrestrial environment. A mathematical model was constructed simulating selected terrestrial pathways by which fallout radioactivity can be transferred ultimately to man. This model is intended for preliminary predictions of radionuclide intakes by man through consumption of milk, beef, and plant parts contaminated directly by fallout as well as by uptake from the soil. Differential equations were written describing the radionuclide transfers, and the parameters required to implement these equations were derived. In verification tests, model predictions of ^{137}Cs concentrations in environmental compartments agreed within a factor of 2 with experimental data. More extensive verification studies involving other radionuclides are needed. The intake rates and total intakes of seven sample radionuclides were predicted for a reference man based on a hypothetical fallout of 1 pCi/cm^2 of each radionuclide. These predicted intakes were used as input to an internal dosimetry model, which calculated dose commitments for each radionuclide and pathway. The results of these calculations are discussed in relation to individual radionuclide contributions to dose commitment. This generalized food-chain model is sufficiently versatile that it can be applied to many terrestrial environments and to all radionuclides. This first version of the model is expected to undergo future refinements. (auth)

30286 USE OF DIGITAL PHANTOMS AND A SIMULATION OF THE SCANNING PROCESS TO EVALUATE TECHNIQUES OF COMPUTER FOCUSING OF AREA SCANS. Krackow, K. A.; Duncan, M. L.; Gorten, R. J. (Duke Univ. Medical Center, Durham, NC). Int. J. Nucl. Med. Biol.; 1: No. 1, 29-35(Jan 1973).

The usefulness of digital phantoms and computer simulation of the scanning process to evaluate computer methods for improving the presentation of scan data is demonstrated. Knowledge of the exact radioactivity distribution, i.e., the digital phantom, producing a given scan allows effective evaluation of computer techniques designed to improve that scan. As an example, the iterative focusing technique of Nagai et al. is analyzed in detail. Long computation time, previously considered to be the most significant limitation of this technique, is less limiting with ordinary line and column spacing factors. This analysis implicates instead other limiting factors as being more significant. The actual degree of focusing or deconvolution achieved, the sensitivity of the method to smoothing techniques, and the stated criterion for a satisfactorily focused result may represent more important limitations than computer time requirements. The criterion for satisfactory solution by a deconvolution technique is basic to all such methods. This work with digital phantoms and scan simulation has indicated possible inadequacies of relying on the similarity of images to infer the same degree of similarity between objects. Work is cited which may permit an investigator to know quantitatively the limitations of such an inference. This application of computer simulation of area scans from digital phantoms suggests the use of similar procedures first to analyze and then to aid in the modification and improvement of digital computer techniques of scan analysis. (auth)

30287 USE OF FALLOUT ^{90}Sr DATA IN ICRP PUBLICATION 20. Bennett, B. G.; Harley, J. H. (Health and Safety Lab. (AEC), New York). Health Phys.; 25: No. 4, 451-452(Oct 1973).

In ICRP Publication 20 (Health Phys.; 24: 125(1973)) use is made of British and New York fallout ^{90}Sr diet and bone data to test the model for alkaline earth metabolism in man. Because there is a discrepancy in fitting the New York bone data to this model it is suggested in the ICRP report that there could be an error in this data but it is stressed here that models must be judged by data and not the other way round. In addition, the ICRP report points out a change in the ratio of New York to British diet ^{90}Sr content as a further reason to question the New York data but the present authors feel that the New York data are less uncertain than the British. The reasons for the changes in the total diet-to-milk ratio, which were considered as due to error by the ICRP report, are given and are considered not unexpected. (UK)

30288 DIETARY STRONTIUM-90 INTAKE IN CHICAGO. Kramer, L. (Veterans Administration Hospital, Hines, IL); Spencer, H.; Hardy, E. P. Health Phys.; 25: No. 4, 445-448 (Oct 1973).

The ^{90}Sr content of constant metabolic non-milk diets was determined over a 10-yr period in the Chicago area and the results obtained were compared with the ^{90}Sr content of diets from the Chicago area determined in the quarterly Health and Safety Laboratory (HASL) program. The HASL milk and non-milk diets contained more ^{90}Sr than the constant non-milk metabolic diets. The changes of the ^{90}Sr content in all diets over the years reflected the annual ^{90}Sr fallout in Chicago. (UK)

30289 PLUTONIUM UPTAKE BY CELL CULTURES IN PRESENCE OF SOME CHELATING AGENTS. Popplewell, D. S. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Health Phys.; 25: No. 4, 413-420(Oct 1973).

A study was made of the uptake of plutonium into HeLa-S3 and Chang liver cells. The influence of various chelating agents on this uptake was examined, the object being to set up a method of assessment of the value of potential therapeutic agents for the removal of accidentally ingested plutonium from humans. Although it was shown that chelating agents that alter the distribution of ingested plutonium in animals are capable of influencing the rate of uptake of plutonium into cultured cells, there are variations in results between different cell species. This means that the cell culture evaluation method for chelating agents can only be used to supplement rather than replace animal experiments. (auth)

30290 DEUTERIUM AND OXYGEN-18 CONTENT OF HUMAN BODY FLUIDS AND THE EFFECT OF CHANGE OF LOCATION.

Zimmermann, U. (Paedagogische Hochschule, Heidelberg); Cegla, U. Naturwissenschaften; 60: No. 5, 243-246(1973). (In German).

Compared with drinking water, human blood is enriched to a higher degree in the stable isotopes deuterium and ^{18}O. In Central Europe the isotope content of human blood is not very much influenced by isotope exchange with atmospheric moisture and does not fluctuate with time. Change of location frequently induces a change in the isotope content of blood. After a characteristic time of a few weeks, a new isotope equilibrium value is reached. (auth)

30291 HEALTH PHYSICS PROBLEMS OF INTERNAL CONTAMINATION. Proceedings of the IRPA Second European Congress on Radiation Protection, Budapest, Hungary, May 3–5, 1972. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973). 655p. (CONF-720503-). $24.00.

Separate abstracts were prepared for 102 of the 106 papers in these proceedings. Abstracts of four papers appeared previously in Volume 27 of NSA as abstract numbers 2827, 7645, 7789, and 9841. (ERB)

For abstracts of individual papers see: 29785, 29832–29836, 29846, 29861–29866, 29874, 29882–29884, 29898, 29945, 30104, 30105, 30184–30186, 30260–30276, 30279–30282, 30292–30325, 30348–30368, 30762, and 31736.

30292 ORGANISM TRANSFER FUNCTIONS EXPRESSED BY MEANS OF THE LANGUAGE OF SERVOMECHANISM THEORY. Schaeffer, R. (Electricite de France, Paris). pp 95-99 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

While with the normal algebraic symbols the response of a system can only be set up for particular and thoroughly determined forms of the input, the Laplace transformation, used in the servomechanism theory, allows one to express the transfer function in a form which is independent of the input and therefore characterizes perfectly the system. This function can be applied to any form of input in order to obtain the output: the calculation can be quite simplified. This method is applied to the calculation of the endogenous excretion of a nuclide (either soluble or insoluble in the organism fluids) following contaminations by inhalation which can appear in several forms. (auth)

30293 EXPERIMENTAL AND MATHEMATICAL PROCEDURES FOR THE CALCULATION OF METABOLIC CONSTANTS IN COMPARTMENT MODELS OF Na, Cs, Ca, Sr, AND I RADIOISOTOPE METABOLISM. Likhtarev, I. A.; Shamov, V. P. (Inst. of Radiation Hygiene, Leningrad). pp 161-166 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

See CONF-720503.

Generalized four compartment analysis of the metabolism of some biologically significant radioisotopes is discussed. The biological adequacy of compartments is considered and the direction of nonzero communications is shown in working models. Some values of the compartment model constants are presented. These values were derived from tracer experiments and by treatment of published experimental data. (auth)

30294 INTERNAL DOSIMETRY OF ^{85}Sr, ^{18}F, AND ^{99m}Tc POLYPHOSPHATES IN BONE SCANNING. Colombetti, L. G. (Loyola Univ., Chicago); Hupf, H. pp 167-170 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Reactor produced ^{85}Sr (T = 64 d, 514 keV photon) prepared as the chloride or nitrate and ^{18}F (T = 1.8 h, 511 keV photon), produced in a cyclotron or a reactor and prepared as sodium fluoride, are used in bone scanning without additional preparation. Recently, a polyphosphate complex of ^{99m}Tc(T = 6 h, 140 keV photon), prepared by the user, was introduced for bone scanning. The biological distribution of each radiopharmaceutical has been assembled and the internal radiation dose to vital organs from each product is presented. (auth)

30295 SOME NEW RESULTS ON THE ABSORPTION OF ^{59}Fe IN MAN. Bozoky, L. (National Oncological Inst., Budapest); Graf, F.; Gazso, J.; Jakab, I. pp 197-201 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Additional information was obtained on the absorption of iron in health and disease with whole-body counting. The portion of the given dose retained after 10 days was defined as absorbed. The measurements were performed in whole-body counter HY 1.1. The steel walls, floor, and ceiling of the shielding chamber are 20 cm thick covered with 5 mm thick lead and 1 mm copper. The geometric arrangement used for the measurements is the standard-chair technique, the detector is a plastic scintillator. The results are demonstrated in diagrams. (auth)

30296 RETENTION AND ELIMINATION OF ^{115m}Cd IN MAN. Rahola, T.; Aaran, R. K.; Miettinen, J. K. (Univ. of Helsinki). pp 213-218 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Retention and elimination of cadmium was studied in five healthy adult male subjects using the isotope ^{115m}Cd and the whole-body counting technique. Labelled cadmium was given orally in a kidney homogenate. Each volunteer ingested a single dose of about 5 μCi ^{115m}Cd and 100 μg Cd element. The whole-body radioactivity of the subjects was determined over a period of three months. The subjects collected 24-hour samples of urine and feces, which were then gamma-counted for the ^{115m}Cd-activity. Blood samples were taken and the radioactivity was measured. During the first 3 to 5 days, about 75% of the ^{115m}Cd dose was eliminated in urine and feces. Rapid elimination continued until about 6% of the dose remained in the whole body. The biological half-time of Cd was found to be at least a few hundred days, but probably much longer. (auth)

30297 PRIMARY DEPOSITION OF AEROSOL PARTICLES IN THE HUMAN RESPIRATORY TRACT IN RELATION TO PARTICLE SIZE, BREATHING PARAMETERS, AND REGION OF DEPOSITION. Przyborowski, S. (National Centre for Radiation Protection, Berlin). pp 239-243 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

In vivo investigations of primary deposition in the human respiratory tract are described using a combined experimental–mathematical procedure. The obtained deposition values are discussed in relation to the region of the respiratory tract, breathing parameters, and particle size. The applicability to PuO_2-aerosol is shown. (auth)

30298 BIOLOGICAL HALF-LIFE OF ^{144}Ce IN THE HUMAN CHEST AS DETERMINED FROM IN VIVO MEASUREMENTS FOLLOWING AN ACCIDENTAL INHALATION. Tyler, G. R.; Lister, B. A. J. (Dounreay Experimental Reactor Establishment, Thurso, Scotland). pp 249-253 of Health Physics Problems of Internal Contamination. Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Following the accidental inhalation by a worker of an aerosol of mixed fission products, predominantly ^{144}Ce, measurements were made of the activity in the chest over a period of about 400 days. The ^{144}Ce was found to be leaving the chest with a biological half-life of about 570 days, considerably longer than the ICRP value of 120 days for the half-life in the lungs. Scanning of the body with a collimated detector showed that the peak of the ^{144}Ce activity was initially at a position more distal in the chest than the peak of the $^{95}Zr/^{95}Nb$ activity and that the ^{144}Ce peak moved further distally in the chest with increasing time. Measurements made of the activity of the radioactive daughter of ^{144}Ce, ^{144}Pr confirmed the direct measurements of ^{144}Ce activity. (auth)

30299 TRANSPORT KINETICS OF TRITIUM OXIDE IN HUMAN BODY. Balonov, M. I.; Dolgirev, E. I.; Likhtarev, I. A. (Inst. of Radiation Hygiene, Leningrad). pp 255-261 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The transport kinetics of body fluids was studied after an intravenous injection, inhalation, and ingestion of THO. The excretion of incorporated tritium was followed during 300 days. The mathematical compartment model of THO metabolism was set up. The full set of model parameters was obtained. (auth)

30300 EXPERIMENTAL ANALYSIS OF THE BEHAVIOR OF Cs IN MAN. Clemente, G. F. (CNEN, Rome); Mariani, A.; Santoroni, G. P. pp 283-286 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A known amount of ^{132}Cs was orally administered to a group of three males and four females 20 to 25 years old. All the excreta and blood samples were collected and measured together with the

body burdens of the subjects at fixed intervals. The differences between the patterns of the total Cs excretion and retention, the ratios (Cs urinary excretion)/(Cs fecal excretion), and the blood concentrations, were studied as a function of sex. The results obtained seem to show: (1) The long half-life retention component is shorter in females than in males; (2) There is an intermediate retention component whose half-life is about 11.5 days; (3) The ratio (fecal excretion)/(urinary excretion) could depend upon sex. All the data obtained are here critically discussed in order to assess the Cs metabolic pathways in man. (auth)

30301 HANDLING OF ACCIDENTAL CONTAMINATIONS. Koenig, W. (National Centre for Radiation Protection, Berlin); Rossbander, W.; Ott, R. pp 287-289 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Wide-spread contaminations with sealed sources of ^{90}Sr, ^{241}Am, and ^{192}Ir caused by accidents in handling are discussed. The differences between the prescribed and realized measures are explained. The results of monitoring for surface-contamination and internal-contamination as well as of the medical examination of persons involved are presented. The contribution of such accidental contaminations to the exposure of occupationally exposed personnel is discussed. (auth)

30302 DISTRIBUTION OF RADIOACTIVE AND STABLE CESIUM IN THE HUMAN BODY. Pietrzak-Flis, Z. (Central Lab. for Radiological Protection, Warsaw). pp 335-339 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The concentration of stable and radioactive cesium and potassium was determined in the different tissues from eleven autopsies. The highest concentration of the above elements was in muscles and it was slightly lower in pancreas and spleen. The lowest concentration of ^{137}Cs was found in bones. Concentration of ^{137}Cs in brain was close to the average in all tissues. The average amount of stable cesium, estimated for the body of the standard man, was 0.92 ± 0.28 mg. (auth)

30303 ^{90}Sr CONCENTRATIONS IN HUMAN BONES. The Ratio of Spongious/Compact Bone in Relation to Age and Time. Brezik, Z.; Brezikova, D.; Kunz, E.; Namaestek, L. (Inst. of Hygiene and Epidemiology, Prague). pp 435-439 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Comparison of ^{90}Sr concentrations in vertebrae (V) and femoral diaphyses (D) in the years 1968 to 70 confirms distinct nonuniformity of ^{90}Sr deposition in the skeleton of adults, the ratio of V/D in the last years indicates a mild decrease. Differences in bones of children are inconspicuous. (auth)

30304 EQUIPMENT FOR INCORPORATION ANALYSIS OF THE MEDICAL DEPARTMENT OF THE NATIONAL CENTRE FOR RADIATION PROTECTION OF THE GDR. Poulheim, K. F.; Loessner, V.; Schlueter, W. (National Centre for Radiation Protection, Berlin). pp 453-457 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

For the critical examination of incorporations in man beside a medical examination, it is necessary to incorporate various physical methods, and in some cases, a chemical preparation of samples. Equipment for incorporation analysis is described. Technical parameters and details of the construction, especially for human body counters, and some results of the measurements, are given. (auth)

30305 ASSESSMENT OF LOW ENERGY PHOTON EMITTERS IN MAN: TECHNICAL ASPECTS OF DETECTION. Loessner, V. (National Centre for Radiation Protection, Berlin). pp 459-463 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

For in vivo measurements of radionuclides emitting low energy photons, e.g. ^{239}Pu, ^{210}Pb, uranium, and ^{90}Sr, a special whole-body counter system was built up consisting of two large-area proportional counters and a CsI(Tl)/NaI(Tl)-sandwich detector. The pulses from both detection systems are shaped and analysed in respect to pulse-height and rise-time. A generalized pulse shape analyzer was developed for this purpose. (auth)

30306 THOROTRAST CASES IN CZECHOSLOVAKIA. Dvorak, V. (Charles Univ., Prague); Malatova, I.; Tuscany, R. pp 485-488 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The number of thorotrast administrations performed in the country was estimated. In a radiotoxicological study dosimetric, clinical, and cytogenetic aspects were studied. Some results are presented. (auth)

30307 DETERMINATION OF ^{239}Pu IN A LIVING HUMAN ORGANISM FROM THE RATE OF ITS ELIMINATION. Osanov, D. P.; Filatov, V. V.; Tissen, M. Y. (Inst. of Biophysics, Moscow). pp 491-496 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

On the basis of a model of the transport of inhaled plutonium in the human organism the relation was established between the content of plutonium in the entire body and the rate of its excretion with the urine at the same time interval. This correlation was obtained as a function of time for different regimens of plutonium aerosols penetration with a diverse degree of dispersion and solubility. The results presented graphically may be utilized for assessing the content of plutonium in the organism in its single and continuous penetration. (auth)

30308 IN VIVO COUNTING OF TRANSURANIUM ISOTOPES IN THE HUMAN BODY: ^{239}Pu AND ^{241}Am. Dolgirev, E. I.; Kaidanovsky, G. N.; Shamov, V. P. (Inst. of Radiation Hygiene, Leningrad). pp 497-502 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The method of the determination of plutonium and americium deposited in human lungs, liver, and skeleton is described. Calibration of a scintillation counter [NaI(Tl), h = 0.1 cm, S = 177 cm^2] and a proportional counter (Ar-CH_4, h = 7.5 cm, S = 300 cm^2) is made with a phantom providing variable thickness of tissue absorber. Activity distribution in three subjects is presented. (auth)

30309 IN VIVO MEASUREMENTS OF ^{239}Pu IN MAN. Clemente, G. F. (CNEN, Rome). pp 503-507 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Plutonium-239 measurements in the lungs were started with the whole-body counter of the Casaccia Nuclear Centre in 1970. The aim of the research done in ^{239}Pu counting is to get an "in vivo" sensitivity of about 5 to 10 nCi, depending upon the body size of the measured subjects. Three different counting equipments have been analyzed: (a) A thin 125 mm × 2 mm NaI(Tl) crystal. This detector was not suitable for its too low sensitivity (≈30 nCi). (b) A twin crystal composed by a 125 mm × 0.5 mm NaI(Tl) crystal optically coupled to a 125 mm × 50 mm CsI(Na) crystal. The two crystals were used together with a pulse shape discrimination system. A sensitivity of about 4 nCi was obtained with such a counting equipment. (c) A home-made proportional counter composed of a main counter and three independent anticoincidence counters. A critical discussion of the three counting equipments examined is reported with the results obtained. (auth)

30310 CRITICAL STUDY OF INTERNAL EXPOSURES BY URINALYSES IN ATOMIC ENERGY OPERATIONS AT TROMBAY. Rudran, K. (Bhabha Atomic Research Centre, Bombay). pp 509-513 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Body burden measurements by urinalyses are carried out in Trombay and other nuclear installations in the country. Starting from about 300 samples in 1958, 1500 samples of urine are presently examined annually for a large number of radionuclides. An analysis of exposure data shows that (i) in normal operations the exposures reduce with time in chemical plants, (ii) in reactors they tend to increase and (iii) the general exposure levels are low and satisfactory. Acute exposures in some cases have yielded useful information on routes of excretion. Where skin injury occurred, the fecal excretion was greater in the case of Pu, ^{203}Hg, and some fission products. Tritium data gave information on T_b variation with season and individuals. Radioiodine excretion showed the well recognized two compartment system with corresponding rates of excretion. A limited evaluation of creatinine index for determining voiding time carried out in a controlled experiment involving five volunteers over a month did not indicate that creatinine excretion is a useful guide. (auth)

30311 DESIGN OF EXHALATION LABORATORY FOR ^{14}C, ^{3}H, AND ^{222}Rn. Schlueter, W. (National Centre for Radiation Protection, Berlin). pp 515-519 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The exhalation analysis of ^{3}H, ^{14}C, and ^{222}Rn will be extended to a routine method in our institution. For the measurement of exhaled low-radon content the influence of radon activity from previously inspired environmental air must be suppressed. Therefore, an exhalation room was designed with a "radon-free" air system that supplied the room. The systems for breath sample collection, enrichment and measurement of radionuclides are reported. (auth)

30312 EXHALATION RADIOMETRY OF ^{14}C IN ORGANISM USING A CO_2 COUNTER. Prokofiev, O. N.; Karazik, A. S. (Scientific Research Inst. of Radiation Hygiene, Leningrad). pp 539-541 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A device is discussed for exhalation radiometry of ^{14}C using gas filled CO_2-counter: CO_2 is the counting gas. Due to the improvement of the counter (quartz covering, use of a quenching gas, and a circuit of external quenching) good counting characteristics were achieved in the Geiger region whereas the pressure of CO_2 is close to the atmospheric pressure. In this way it was accessible a high concentration of CO_2 in the operation volume of the counter and a registration efficiency of nearly 100% for ^{14}C beta-particles. Due to the counter protection ring with the anticoincidence circuit and 7 cm cast iron screening the background was suppressed to 4 to 5 cpm. With a sensitive volume of 30 cm^3 and by 3% CO_2 content in the exhaled air of man, the sensitivity was 2×10^{-12} Ci ^{14}C per 1 liter exhaled air. (auth)

30313 RISK OF INTERNAL CONTAMINATION: ITS INFLUENCE ON MONITORING PROGRAMS. Rehak, W. (National Centre for Radiation Protection, Berlin). pp 549-552 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Risk of internal contamination is thought to be a criterion to determine the extent of monitoring programs for internal contamination. An attempt is made to evaluate this risk considering such factors as specific activity, duration and frequency of handling isotopes, maximum permissible annual intake, and probability of uptake. The application of this evaluation is shown for internal contamination with crud formed in nuclear power plants with pressurized water reactors. (auth)

30314 RISK OF INCORPORATION AND EXPERIENCES AT WORKING PLACES USING SEALED SOURCES. Gacs, F. (Municipal Public Health Epidemics Inst., Budapest); Lendvay, J.; Predmerszky, T. pp 553-556 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

On the basis of experiences gained on account of accidents with sealed sources it can be established that one has to reckon with incorporation risk in this field, too. For the uniform assessment of sealed sources the value of risk is defined, $r_s = (A - T) + E + P$. The value of r_s characterizes the incorporation risk and the required form of radiation hygienic control. Given this knowledge, the public health authority can make the first administrative arrangements. In the light of practice developed on the basis of the r_s value, the measures taken in Hungary in the course of the last 15 years are in harmony with the degree of risk. (auth)

30315 NEW MODIFYING FACTORS TO CALCULATE THE INTERNAL RADIATION RISK CONCERNING THE REGULATION ASPECTS IN THE DESIGN AND CONTROL OF LABORATORIES. Roka, O. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest); Predmerszky, T.; Lendvay, J.; Gacs, F. pp 557-559 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

According to experiences with isotopic work, the official licensing and control of same necessitates the more elastic assessment of incorporation risk than would be possible according to the A-B-C laboratory levels developed on the basis of the recommendations. In the light of precedents reported on in literature, modifying factors were developed for the determination of radioactivity that can be stored and applied in isotopic working places. These modifying factors relate to the toxicity of the isotope applied, to the surface and air contamination risk involved by the procedure, to the architectural parameters, the crowdedness of the working places, the automatisation degree of the instrument pool, and to the routine of the staff. In principle, the application of the suggested modifying factors does not differ from the sense of the former regulations, but they are better conforming to the demands of life. (auth)

30316 PROCEDURES USED AT THE INSTITUTE OF NUCLEAR RESEARCH (INR) WARSAW, POLAND TO INDICATE PERSONS WITH INTERNAL CONTAMINATION BY GAMMA EMITTERS. Cwik, T. (Inst. of Nuclear Research, Poland). pp 561-564 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The methods used at the Institute of Nuclear Research (INR) Warsaw, Poland for individual monitoring of workers for internal contamination by gamma emitters are briefly presented. The program of monitoring is based on the use of two whole-body counters and an instrument for measurements of radioiodine (^{131}I and ^{125}I) content in the thyroid. One of the whole-body counters is applied for preliminary monitoring for indication of persons with internal contamination. The simple method of monitoring includes the approximate assessment of ^{137}Cs and ^{40}K contribution to the counts, representing the total body gamma activity. (auth)

30317 RADIATION PROTECTION EXPERIENCES IN ^{131}I RADIOCHEMICAL LABORATORIES. Ringel, P. V.; Rossbander, W. R. (Central Inst. of Nuclear Research, Rossendorf, Ger.). pp 565-567 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The handling of minimum amounts of unsealed radioiodine labeled compounds outside of enclosed production lines along with routine thinking in the working process proved to be the cause of significant iodine uptakes in the thyroid gland. (auth)

30318 ROUTINE THYROID MONITORING OF ^{131}I-PRODUCTION WORKERS. Nooteboom-Beekman, Z. M.; Sckers, J. G. (Reactor Centrum Nederland, Petten). pp 569-577 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Results of a routine monitoring program of the thyroid in ^{131}I-production workers over the year 1971 are given. In this program, γ-measurements over the thyroid are carried out at 3-week intervals. Theoretical considerations lead to the choice of this 3-week interval. Uncertainty limits in the dose assessment when the intake pattern is not known, are given. The results are interpreted in terms of dose-commitments to the thyroid. When intake-dates are known, the connected dose-commitments are easily calculated. When the intake-date cannot be determined, the most probable dose-commitment can be calculated, together with limits of uncertainty. (auth)

30319 SAFETY CRITERIA OF SURFACE CONTAMINATION BY RADIOACTIVE SUBSTANCES AS AN IMPORTANT MEANS FOR RADIATION PROTECTION OF OCCUPATIONAL WORKERS FROM INTERNAL RADIATION EXPOSURE. Badin, V. I.; Margulis, U. Y.; Mirkhaidarov, A. K.; Sayapina, R. Y.; Krushch, V. T. (Inst. of Biophysics, Moscow). pp 579-582 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Scientifically grounded permissible levels (PL) make it possible to avoid overirradiation, to estimate the radiation situation and the efficiency of sanitation measures. Radiation standards are presented for surface contamination by radioactive substances. (auth)

30320 MAIN RESULTS OF WORK ON DEVELOPMENT, INVESTIGATION, AND SETTING OF WORKING STANDARDS FOR PERSONAL PROTECTION IN FACILITIES FOR HANDLING RADIOACTIVE SUBSTANCES IN THE USSR. Gorodinsky, S. M. (Inst. of Biophysics, Moscow). pp 583-586 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Data on the creation and investigation of personal protective facilities used in handling radioactive substances, based on the

long experience in their use in the Soviet Union are presented. Data on hygienic standards are given and methods of protective and physiological estimate are discussed. (auth)

30321 STUDY OF A CASE WHICH INVOLVED A WOUND CONTAMINATED WITH INSOLUBLE Pu AND ^{241}Am. Testa, C.; Delle Site, A. (CNEN, Rome). pp 593-599 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

During a polishing operation of a plutonium ceramic sample a technician wounded his right index finger. The first rough evaluation indicated a plutonium activity of about 120 nCi; a small excision of the wound was carried out therefore within 30 min. The original activity was thus reduced 20 times; as a precautionary measure DTPA was given intravenously within 90 min from the contamination. Samples of urine, blood, skin, and cotton wool were soon collected and the activity of plutonium determined. A 0.2% w/w concentration of ^{241}Am was found and the efficiency of the x-ray probe calculated more precisely. The plutonium activity in the finger, feces, and urine samples was followed for 10 months; from these results it appears that the prompt surgical treatment reduced the initial contamination (~70 nCi) to a very low level (~0.2 nCi) and minimized the systemic burden (~0.5 nCi). (auth)

30322 ASSESSMENT AND MANAGEMENT OF A PLUTONIUM CONTAMINATED WOUND CASE. Howells, H.; Schofield, G. B.; Lynn, J. C.; Ward, F. A. (British Nuclear Fuels Ltd., Seascale). pp 601-603 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A plutonium contaminated wound case is described. Initially 14.2 μCi were present at the wound site. After two excisions about 1.8 μCi remained. Measurements of the activity were also made along the line of the lymphatic drainage and in the liver region. DTPA was administered. Urinary excretion data indicated a systematic uptake of 1.2 μCi. (auth)

30323 HEALTH PHYSICS PROBLEMS ASSOCIATED WITH THE OPERATION OF NEUTRON GENERATORS. Sauermann, P. F.; Schaefer, W. (Nuclear Research Center, Juelich, Ger.). pp 605-611 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From second European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

During the planning and operation of neutron generators for the production of 15-MeV neutrons using the $^{3}H(d, n)^{4}He$-reaction, the relevant considerations are generally focused on shielding problems. However, the activity of the tritium targets used in these generators amounts to about 100 Ci. Thus the contamination and incorporation hazards associated with the handling of targets, the opening of the vacuum system, and any incidents such as leakage or breakage should not be underestimated. In this paper our experience regarding the measures to be taken for protection of occupational workers and environment against contamination and the methods and results of air and surface contamination measurements is reported. This information is completed by a comparison between the risks in the operation of open-type generators and of those with sealed tubes. (auth)

30324 EXPERIENCES OF ^{3}H AND ^{14}C INCORPORATION MONITORING DURING THE PREPARATION OF LABELLED COMPOUNDS. Cziboly, C.; Uchrin, G.; Biro, T. (Inst. of Isotopes, Budapest). pp 613-616 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The internal contamination monitoring used in the Organic Chemical Laboratory is described. The results obtained from area and personal monitoring are summarized and their comparison is discussed. The accuracy of the used intake model is investigated. (auth)

30325 EXPERIENCES OF INTERNAL CONTAMINATION MONITORING DURING THE PROCESSING OF INORGANIC RADIOACTIVE COMPOUND. Golder, F.; Uchrin, G.; Biro, T. (Inst. of Isotopes, Budapest). pp 617-623 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Data obtained from whole-body counting, ^{131}I and ^{125}I thyroid measurements, and ^{90}Sr urine analysis are given. A comparison of external and internal exposures is made. (auth)

30326 DISTRIBUTION OF RADIONUCLIDES IN THE NORMAL AND DISEASED BRAIN; FUNDAMENTALS; THEORETICAL CONSIDERATIONS. Zeidler, U. (School of Medicine, Hanover). J. Nucl. Biol. Med.; 16: No. 4, 289-294(1972).

The possible mechanisms of accumulation of radioactive tracers in cerebral lesions are discussed according to the present state of knowledge. As far as the uptake of radioactive material in cerebral tumors of neuroglial as well as mesodermal origin is concerned, the following factors have to be taken into account: Vascularization of the brain lesion, permeability of the tumor vessels, the extracellular space of the tumor; and the invasion of the radioactive substance into the tumor cell itself. Permeability of tumor vessels and an enlarged extracellular space of the tumor appear to be the most important factors in tumor demonstration by scintigraphy. The mechanisms or radioactive uptake in cerebro-vascular lesions seem to be completely different and closely related to necrosis and resorption processes, as well as dependent on the barrier-properties of newly formed vessels in the diseased region. However the underlying principles are not fully understood yet and there is still no reasonable explanation in those cases that do not pick up radioactive tracers at all. Accumulation of radioactive tracers in subdural hematoma and hygroma seems to be exclusively dependent on the formation of membranes while understanding of the sometimes intensive uptake of arterio-venous malformations still remains a problem since the enlarged blood-pool in cases of angioma is not a sufficient explanation. (auth)

30327 CYTOGENETIC STUDIES ON BLOOD LYMPHOCYTES OF FOUR PATIENTS WITH FRACTURE OF THE FEMUR INJECTED WITH TRITIATED THYMIDINE ($^{3}HTdR$). Lisco, H.; Lisco, E.; Adelstein, S. J.; Banks, H. H. (Harvard Medical School, Boston). Int. J. Radiat. Biol.; 24: No. 1, 45-57(Jul 1973).

A study was made of the effects of tritiated thymidine on the chromosomes of circulating lymphocytes in four elderly female patients with fracture of the femur who had received a single dose of $^{3}HTdR$ (0.1 mCi/kg) as part of a study of cell proliferation in osseous repair. Cytogenetic examination showed a high frequency of chromosome aberrations in the pre-injection samples but no increase in the incidence of these after the injection of $^{3}HTdR$. The pattern of aberrations and their frequency, in any one patient, were remarkably uniform throughout the period of observation. Radioautographs of PHA-stimulated lymphocytes showed labelling of interphase and metaphase nuclei. No aberrations were seen in the labelled metaphase cells. The labelling index decreased with time following tritium administration. Daily urinary collections were obtained from two patients to estimate the dose from the metabolically derived THO. Absorbed doses calculated from THO were 540 and 940 mrem. When tritium incorporated into DNA is also taken into account, it is estimated that the absorbed dose of radiation delivered to the patients' lymphocytes was of the order of 1 to 5 rads. (auth)

30328 USE OF YTTRIUM-90 IN PERSISTENT SYNOVITIS OF THE KNEE. Pt. 1. Retention in the Knee and Spread in the Body After Injection. Gumpel, J. M. (Northwith Park Hospital, Harrow, Eng.); Williams, E. D.; Glass, H. I. Ann. Rheum. Dis.; 32: No. 3, 223-227(May 1973).

Yttrium-90 is now increasingly used in place of ^{198}Au in the treatment of chronic synovitis in the knee due to the greater penetration of its β particles, the absence of undesirable γ radiation, and the apparently small loss from the knee. The use of a quantitative scanning method for estimating both the amount of ^{90}Y retained in the knee and its distribution in other sites in the body after injection of yttrium colloid resin is described. The study shows reasonably good retention in the knee, a mean of 77.8% of the injected dose still being present in the knee 5 days after injection. Difficulties experienced in calculating the radiation dose to the synovial membrane are discussed. Uptake of ^{90}Y in the regional lymph nodes is compared with previously reported results for ^{198}Au from which it is seen that there is a significantly higher proportion of patients with lymph node uptake of < 1% of the dose using ^{90}Y (49%) compared to ^{198}Au (11%). It is concluded that ^{90}Y appears to be a more suitable radionuclide than ^{198}Au for injection in the knee. (UK)

30329 MANHATTAN PROJECT PLUTONIUM WORKERS. A Twenty-Seven Year Follow-Up Study of Selected Cases. Hemplemann, L. H.; Langham, W. H.; Richmond, C. R.; Voelz, G. L. (Los Alamos Scientific Lab., NM). Health Phys.; 25: No. 5, 461-479(Nov 1973).

Twenty-five male subjects who worked with plutonium during World War II under extraordinarily crude working conditions were followed medically for a period of 27 yr. Within the past year, 21 of these men were examined at the Los Alamos Scientific Laboratory, and three more will be studied in 1973. In addition to physical examinations and laboratory studies (complete blood

count, blood chemistry profile, and urinalysis), roentgenograms were taken of the chest, pelvis, knee, and teeth. The chromosomes of lymphocytes cultured from the peripheral blood and cells exfoliated from the pulmonary tract were also studied. Urine specimens assayed for plutonium gave a calculated current body burden (excluding the lungs) ranging from 0.005 to 0.42 μCi, and low-energy radiation emitted by internally deposited transuranic elements in the chest disclosed lung burdens probably of less than approximately 0.01 μCi. To date, none of the medical findings in the group can be attributed definitely to internally deposited plutonium. The bronchial cells of several of the subjects showed moderate to marked metaplastic change, but the significance of these changes is not clear. Diseases and physical changes characteristic of a male population entering its sixth decade were observed. Because of the small body burdens on the order of the maximum permissible level in these men so heavily exposed to plutonium compounds, it is concluded that the body has protective mechanisms that are effective in discriminating against these materials following some types of occupational exposures. This is presumably explained by the insolubility of many of its compounds. Plutonium is more toxic than radium if deposited in certain body tissues, especially bone; however, from the practical point of view, plutonium seems to be less hazardous to handle. (auth)

Animals

Refer also to abstracts 29839, 29891, 29895, 30170, 30175, 30185, 30188, 30202, 30279, 30282, 30284, and 32147.

30330 (CONF-710501-P2, pp 840-848) RATE OF ZINC UPTAKE BY DOVER SOLE IN THE NORTHEAST PACIFIC OCEAN: PRELIMINARY MODEL AND ANALYSIS. Vanderploeg, H. A. (Oregon State Univ., Corvallis). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

This paper presents a specific-activity (SA) model that describes the relationship between the SA of a fish (or any predator) and the SA of its prey. The model serves as the basis for the hypothesis that lowered feeding intensity is the major factor causing the decreased excretion rate constant observed with increasing body weight for zinc and some other elements. Furthermore, the model facilitates understanding of SA differences observed among different species. The model is applied to a free-living population of Dover sole to calculate the zinc uptake constant for the population. The value obtained for the population is lower than the values obtained from the laboratory retention studies of other workers. The feeding-intensity hypothesis predicts these differences. (auth)

30331 (CONF-710501-P2, pp 866-874) ACCUMULATION OF CALCIUM-45 IN DEVELOPING COHO SALMON EGGS AND FRY REARED IN VARYING CONCENTRATIONS OF STABLE CALCIUM. Olson, P. R. (Univ. of Washington, Seattle). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Coho salmon eggs were fertilized and reared in ^{45}Ca solutions that contained varying amounts of stable calcium, ranging from 6 to 76 mg/liter. As evidenced in one of two egg lots, the eggs in calcium concentrations above 6 ppM showed a significant improvement in fertility. Eggs reared in 76 ppM calcium hatched a day earlier than those reared in calcium concentrations of 16 and 36 ppM, which in turn hatched a day earlier than the egg lots reared in 6 ppM calcium. The stable calcium accumulated during the rearing period, 80 days, was similar in all lots regardless of the concentration of calcium. The amount of ^{45}Ca accumulated was inversely proportional to the concentration of stable calcium. A significant amount of ^{45}Ca entered the egg during the water-hardening process, but only a slight amount was taken up during the 57 days to hatching. In the two-week period after hatching, there was at least a tenfold increase in the uptake of ^{45}Ca, which was associated with ossification. (auth)

30332 (CONF-710501-P2, pp 909-914) SYSTEMS ANALYSIS OF A MODEL FOR RADIOIODINE MOVEMENT IN MULE DEER. Gist, C. S.; Duke, K. M.; Patten, B. C. (Univ. of Georgia, Athens). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

A three-compartment linear donor-controlled model was constructed. The transfer coefficients of the model were expressed as a sine wave function with two pi radians per year and various phase shifts to simulate seasonal effects on these coefficients. The system was forced by various functions and the dynamics of each examined. The model showed a concentration of radioiodine in the thyroid over that in the plants of 1.293×10^3 in the winter and a concentration factor of 914 in the summer. The concentration values obtained from the model agree quite well with the literature. (auth)

30333 (CONF-710501-P2, pp 1169-1173) CHROMOSOME ABERRATIONS IN CHIRONOMUS RIPARIUS DEVELOPING IN DIFFERENT CONCENTRATIONS OF TRITIATED WATER. Blaylock, B. G. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Since most tritium released to the environment eventually becomes tritiated water, there is a need for data on the biological effects of tritium acquired by organisms from environmental tritiated water. The salivary gland chromosomes of Chironomus riparius, which had developed in different concentrations of tritiated water were examined for chromosome aberrations. The concentration of tritium ranged from 0.01 to 500 μCi/ml. The concentrations of tritium in the larvae were determined, and dose calculations were made for each concentration. Chromosome aberrations were observed in larvae that had developed in concentrations of 125, 250, and 500 μCi/ml of tritiated water; however, no aberrations were detected at concentrations of 0.1 μCi/ml or lower. A response curve developed to relate the frequency of chromosome aberrations to the concentration of tritiated water in which they developed was similar to a two-hit dose response for chromosome aberration produced by x or gamma radiation. (auth)

30334 (FRNC-R-19, pp 106-110) DEVELOPMENT OF RESPIRATORY CONTAMINATION EQUIPMENT FOR MEDIUM SIZED ANIMALS ENABLING SELECTIVE MEASUREMENTS TO BE MADE OF THE EARLY TRANSFER FROM THE DEEP LUNG TO THE BLOOD. Ducousso, R. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

An installation for the radiocontamination of the deep lung (excluding the rhinopharynx and tracheobronchial tract) of medium-sized animals (e.g., monkeys, cats, dogs, and rabbits) is described. Aerosols are used for the radiocontamination. The device operates in accordance with radiological protection rules and enables the deep pulmonary compartment to be studied with a high reproducibility. The device can be used to study the penetration of the alveolar capillary barrier by γ emitters, the transport occurring spontaneously or being induced by special means. (FR)

30335 (FRNC-R-19, pp 111-113) EFFECT OF ADMINISTRATION TIME ON THE THERAPEUTIC EFFICIENCY OF THE DTPA AEROSOL ON RESPIRATORY CONTAMINATION WITH CHELATABLE RADIOISOTOPES. Ducousso, R.; de Regnaud, M.; Matheron, B.; Brazier, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Studies of the effect of the delay in administering DTPA (in aerosol form) on early lung clearance in monkeys contaminated by the inhalation of ^{140}La demonstrated the usefulness of this substance in the emergency treatment of lung contamination with chelatable radioisotopes. The effectiveness of the chelating substance diminishes rapidly if the treatment is delayed. This reduction in effectiveness is due to a rapidly occurring phenomenon (the phagocytosis of newly formed polymers which are subsequently extracted by the action of DTPA) and a slowly occurring phenomenon (the fixing of the ionic fraction of the radioisotope on tissue proteins). (FR)

30336 (FRNC-R-19, pp 114-115) EFFECT OF THE TYPE OF ADMINISTRATION ON THE THERAPEUTIC VALUE OF DTPA FOR RESPIRATORY CONTAMINATIONS WITH CHELATABLE RADIOISOTOPES. Ducousso, R.; de Regnaud, M.; Matheron, B. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Studies of the effect of the way in which DTPA is administered to monkeys on its therapeutic effectiveness in the treatment of respiratory contamination with chelatable radioisotopes (^{140}La) indicated that a small dose of DTPA administered in aerosol form is as effective in decontaminating the lungs as several hundred mg of DTPA administered intravenously. This result is interesting for the cases of individuals suffering from renal insufficiency or serious burns. A complementary study on the kinetics of the penetration of the lung membrane by DTPA demonstrated that the constants concerning the penetration depend upon the kinetics of the passage (slow passage of the blood towards the alveoli or the contrary). (FR)

30337 (FRNC-R-19, pp 116-117) DETERMINATION OF THE OPTIMUM QUANTITY OF DTPA ADMINISTERED IN AEROSOL FORM REQUIRED TO CHELATE A GIVEN QUANTITY OF LAN-

THANUM. Ducousso, R.; Matheron, B. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

The minimum quantity of DTPA (administered in aerosol form) necessary to treat a monkey having previously been contaminated with a ^{140}La aerosol was investigated. In the alveolar medium, the reaction involving the chelation of lanthanum with DTPA appears to be equimolecular. Nevertheless, an excess of DTPA permits a more complete decontamination of the organ, this being due either to the existence of a pool of DTPA whose passage across the blood is delayed, or to an improved washout of the alveolar proteins. The decontamination is however never total, but levels off at about 70%. (FR)

30338 (FRNC-R-19, pp 118-121) EMERGENCY TREATMENT OF A WOUND CONTAMINATED WITH A MIXTURE OF FISSION PRODUCTS. Ducousso, R.; de Regnaud, M. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

A lacerated ^{85}Sr- and ^{144}Ce-contaminated wound was inflicted on a monkey. In order to establish the treatment to be followed, the mechanism involved in the movement of the transferable and nontransferable radioisotopes was established. It is very important that immediate action is taken: rapid intravenous injection of DTPA is the most appropriate therapy for the nontransferable radioisotopes, local surgical treatment of the wound always being necessary. Potassium rhodizonate is an excellent insolubilizer for strontium and its use is preferable to that of magnesium sulfate. There is no compatibility between DTPA and the rhodizonate in the treatment of wounds. (FR)

30339 (FRNC-R-19, pp 205-210) EFFECT OF THYROID PRODUCTS ON THE MITOCHONDRIAL CAPTURE OF ^{85}Sr. Tine, J.; Rocquet, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1971. (In French).

Investigations made using a rapid filtering technique to study the penetration of Sr^{2+} led to the conclusion that phosphates are absolutely necessary for a high accumulation of cations by hepatic mitochondria in rats. The investigations also demonstrate that when succinate is used as the substrate, the triodothyronine and its acetic derivative oppose the capture of Sr^{2+} by the particles and considerably modify the respiratory responses due to the presence of the cation independently of whether this cation was added before or after the hormones. It is also suggested that the thyroid products stimulating the elimination processes such as strontium can also indirectly affect the ossification mechanisms. (FR)

30340 RENAL CLEARANCE IN MICE AS A BIOASSAY FOR RADIOPHARMACEUTICALS: INTERCOMPARISON OF COMMERCIAL SOURCES OF IODOHIPPURATE SODIUM ^{131}I(OIH). Konikowski, T.; Glenn, H. J.; Haynie, T. P.; Farr, L. E. (Univ. of Texas, Houston). Int. J. Nucl. Med. Biol.; 1: No. 1, 37-44 (Jan 1973).

A bioassay method using renal clearance in mice was developed for evaluating and comparing radiopharmaceuticals. The indices measured include renal plasma flow, the percentage cleared by tubular excretion or tubular reabsorption, and the clearance ratio of the sample to inulin. This procedure proved to be reproducible and sensitive enough to distinguish between four sources of the same compound, o-iodohippurate sodium labeled with ^{131}I(OIH). Differences in renal clearance of the four sources are reported and related to formulation, percentage iodide impurity, and nephrotoxicity of a formulation component, propylene glycol. The variation in clearance rates of these different sources of labeled OIH indicates that this compound should probably not be used in sophisticated renal clearance studies, and possibly explain the conflicting evidence and opinions concerning the efficacy of the renogram as a diagnostic test procedure. (auth)

30341 WHOLE-BODY RETENTION OF ^{42}K IN THE RAT. Inaba, J.; Lengemann, F. W. (New York State Veterinary Coll., Ithaca). Health Phys.; 25: No. 4, 443-445(Oct 1973).

Data are presented on the age dependency of whole-body retention of ^{42}K and the effect of weaning on the retention of ^{42}K in rats. Results are compared to those from similar radiocesium studies. The data from both of these kinetic experiments show that the metabolism of radiopotassium is qualitatively the same as was observed for radiocesium, the data, however, do not imply a strict quantitative relationship exists. As with radiocesium it may be deduced that the potassium intake is much greater when rats are changed from rat milk (0.1% K) to a solid commercial rat diet (0.76% K). This change from a low-K diet to a high-K diet acts to allow a faster turnover of potassium and cesium. However the increased retention time of potassium and cesium with increased age is more difficult to explain. (UK)

30342 EFFECTS OF DTPA ON EXCRETION AND TISSUE DISTRIBUTION OF INJECTED ^{238}Pu IN FED AND FASTING RATS. Sanders, C. L.; Meier, D. M. (Battelle Pacific Northwest Labs., Richland, WA). Health Phys.; 25: No. 4, 405-411(Oct 1973).

The influence of fasting on the efficacy of DTPA in enhancing the excretion of intraperitoneally injected ^{238}Pu in female, albino rats was examined. In untreated rats, the ^{238}Pu was rapidly cleared from the abdominal cavity into the blood. The liver burden increased to 15% of injected dose by the 10th day, falling to about 3% by the 35th day after injection. About 45% of injected dose was found in the skeleton after the first day; about 12% of the injected dose was excreted in the urine and 27% in the feces during the first 29 days after injection. Complete fasting for 10 days had no significant effect on the cumulative excretion of injected ^{238}Pu. In animals given DTPA within the first hour after ^{238}Pu there was a 2.2-fold increased excretion, and a 1.4-fold increased excretion when DTPA administration was started at 14 days after ^{238}Pu injection, irrespective of fasting. It was concluded that the distribution of ^{238}Pu bound to ligands in extracellular fluids and bone was not significantly altered by fasting so as to influence the chelation of ^{239}Pu by DTPA. (auth)

30343 HYPERTRANSFUSED MOUSE ASSAY FOR THROMBOPOIETIC FACTORS. Cooper, G. W.; Cooper, B.; Ossias, A. L.; Zanjami, E. D. (City Coll., New York). Blood; 42: No. 3, 423-428(Sep 1973).

A method was developed for the quantitative separation of platelets from CF1 mouse whole blood. This made it possible to determine the platelet incorporation of ^{35}S-sulfate without the necessity of doing platelet counts. Daily hypertransfusions of the mice to three to four times normal platelet levels for 4 to 5 days significantly reduced platelet uptake of radiosulfate to an average of about 40% of the nontransfused controls. Mice rendered thrombocytopenic 48 hr earlier by antiplatelet serum, had 2-day ^{35}S uptakes over $2^1/_2$ times the controls and 6 times the hypertransfused animals. The administration of a total of 2 ml of serum, given twice daily for 3 days from a thrombocytopenic patient with Hodgkin's disease caused a highly significant 103% rise in radiosulfate incorporation when compared with saline in the hypertransfused mouse. Normal human serum from a healthy donor caused a small and insignificant rise. The serum from a patient with Hodgkin's disease caused a highly significant 63% rise in ^{35}S incorporation when compared to the normal serum. (auth)

30344 EFFECT OF LANTHANUM ON ^{45}Ca FLUX AND SECRETION OF PROTEIN FROM RAT EXOCRINE PANCREAS. Heisler, S.; Grondin, G. (Univ., Sherbrooke, Quebec). Life Sci.; 13: No. 7, 783-794(1 Oct 1973).

The relationship between calcium flux and secretion of protein from rat exocrine pancreas was studied. The trivalent cation La^{3+} was used to measure ^{45}Ca uptake. Carbachol increased the uptake of ^{45}Ca into the tissue prior to onset of secretion of α-amylase. La^{3+} inhibited ^{45}Ca uptake in carbachol-stimulated tissue, and also inhibited secretion of protein from the pancreas. Carbachol increased the rate of efflux of ^{45}Ca from the pancreas independently of the presence or absence of La^{3+}. In the presence of La^{3+}, however, the net loss of ^{45}Ca from the tissue was reduced. The data suggest that La^{3+} inhibits ^{45}Ca influx into the pancreas and may additionally displace intracellular calcium. (auth)

30345 RETENTION OF ^{65}Zn, $^{85,89}Sr$, AND ^{144}Ce IN RATS AFTER INTRAMUSCULAR INJECTIONS OF VITAMINS A OR D. Szot, Z.; Geisler, J.; Zylicz, E.; Kloczewiak, M. (Inst. of Nuclear Research, Swierk, Poland). Acta Physiol. Pol.; 24: No. 4, 577-586(1973).

Vitamin A or vitamin D was administered during 6 days intramuscularly to rats weighing 200 g. The total dose of vitamin A was 40,000 i. u., and that of vitamin D was 500,000 i. u. On the 8th day, a radionuclide (^{65}Zn, $^{85,89}Sr$, or ^{144}Ce) was intravenously injected, and its retention in rats was determined with a whole-body counter in the course of 30 days. After radionuclide injection, 10,000 i. u. of vitamin A or 200,000 i. u. of vitamin D were administered intramuscularly to the rats once a week. Vitamin A was found to exert no effect on the retention of the above-mentioned radionuclides. As a result of vitamin D administration, the retention of $^{85,89}Sr$ as compared with the control was reduced by an average of 20%, whereas that of ^{65}Zn was decreased by 7% beginning from the 14th day after radionuclide injection vitamin D failed to affect significantly the retention of ^{144}Ce. (auth)

30346 OXYTETRACYCLINE ADDITIVES TO THE DIET IN RELATION TO STRONTIUM METABOLISM IN RATS. Gruden, N. (Inst. for Medical Research, Zagreb). Arh. Hig. Rada Toksikol.; 23: No. 3, 209-213(1972).

The metabolism of radiostrontium was studied in female albino rats fed a diet with oxytetracycline additives for six months (0.3 g

of calcium oxytetracycline per 100 g dried food). No difference was observed in absorption, skeletal retention, and urinary excretion of strontium-85 between the control group of animals and the rats fed the diet with oxytetracycline additives. (auth)

30347 INVESTIGATIONS INTO THE BIOLOGICAL BEHAVIOR OF RADIO-TECHNETIUM, RADIO-INDIUM, AND RADIO-GALLIUM DURING LACTATION. Hoer, G.; Kriegel, H.; Heidenreich, P.; Schramm, E. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). Int. J. Appl. Radiat. Isotop.; 24: No. 9, 525-529(Sep 1973). (In German).

The biological behavior of ^{67}Ga, ^{113}In, and ^{99m}Tc in blood, mammary glands, femur (mother animals), and in the whole body (young animals) was tested with 105 suckling Wistar rats with an average of eight newborns each, in comparison with non-suckling control animals. It is shown that ^{+}Ga is accumulated progressively to a considerable extent in the newborns between 3 and 24h p.i. via mother's milk. The mammary glands of suckling animals contain ^{67}Ga in four times higher concentrations. The intraossary ^{67}Ga accumulation of suckling animals is low ("decorporation effect" of the lactation). The transfer of ^{+}In via mother's milk is minimal, although twice as much indium is concentrated in the mammary glands as in control animals. A statistically significant difference of the retention behavior of ^{+}In in the bone structure of suckling and non-suckling animals does not exist. The retention curve in the newborns has a biphasal form (rise up to 6h p.i., drop up to 18h, renewed rise). The Tc kinetics in the mammary glands show a parallel pattern. Considerations concerning the differential kinetics of the radionuclides are discussed. (UK)

30348 EVALUATION OF ACTIVITY IN LUNG AND LYMPH NODES FOLLOWING INHALATION OF RADIOACTIVE INSOLUBLE AEROSOLS. Paganini Fioratti, M.; Ricci Piermattei, S. (CNEN, Rome). pp 65-76 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Data available in the literature for the period 1962 to 1972 on the elimination of Pu insoluble compounds from lung and retention in lymph nodes are examined. Through a best fit procedure we try to obtain reliable data on the effective half life of the material contained in the lung and on the fraction of this material transferred to lymph nodes. Using the Kotrappa expression the absorbed dose from lymph nodes is also evaluated. (auth)

30349 KINETICS OF ^{226}Ra, ^{224}Ra AND THEIR DECAY PRODUCTS IN MICE. Malatova, I. (Inst. of Hygiene and Epidemiology, Prague); Thomas, J.; Dvorak, V.; Lenger, V.; Kofranek, V.; Pifflova, L. pp 175-180 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The experimental values of retention of ^{226}Ra, ^{224}Ra, and some of their decay products in mice are fitted to theoretical or empirical relations. It was found that these relations can be considered as suitable models for the dose assessment. (auth)

30350 KINETICS OF ^{210}Po METABOLISM IN PIG FROM SURFACE CONTAMINATION OF SKIN AND ESTABLISHING OF MAXIMUM PERMISSIBLE LEVELS FOR SURFACE CONTAMINATION. Ilyin, L. A.; Khodyreva, M. A.; Sitko, R. Y.; Parkhomenko, G. M. (Inst. of Biophysics, Moscow). pp 203-211 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The metabolism of ^{210}Po applied repeatedly on pig skin in the form of nitrate solution was investigated. The quantitative intracutaneous distribution of ^{210}Po, the biological half-lives of the radionuclides, the values of ^{210}Po percutaneous resorption and its accumulation in tissues and organs were determined. The doses absorbed by the skin were estimated on the basis of the experimental data. The paper also considers the problem of establishing maximum permissible levels (MPL's). (auth)

30351 CONTRIBUTION TO THE PROBLEM OF INTERNAL CONTAMINATION BY 6-^{3}H OR METHYL ^{14}C THYMIDINE. Estimation of BAIBA Specific Activity. Jockey, P.; Geronimi, C.; Tellier, N. (CEN, Saclay, France). pp 219-225 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

See CONF-720503.

The difficulty in estimating contamination by labelled thymidine in a laboratory of fabrication in the presence of other contaminants leads us to follow the fate of the major and specific catabolite of this molecule: BAIBA. A method was elaborated to estimate directly the specific activity of BAIBA in the urine. This was obtained by modifying the classical column chromatography method to obtain simultaneously the usual colorimetric determination and one aliquot used subsequently for liquid scintillation counting. An experimental study was carried out with pigs. Daily and specific activities of BAIBA in the urine were determined after injection of 3 M and 14 C thymidine. Analog computation of the results was made permitting the elaboration of a complex model that was used to interpret human accidental situations at Saclay. (auth)

30352 TIME COURSE OF ^{226}Ra DISTRIBUTION IN SOME BONES OF MICE. Kofranek, V.; Parizek, O.; Machek, J.; Thomas, J.; Hanzlik, J. (Inst. of Hygiene and Epidemiology, Prague). pp 231-234 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The time course of ^{226}Ra distribution was investigated in separated parts of young female mice femur and vertebrae after single injection of 0.03 $\mu Ci/g$ body weight by radiochemistry and SST autoradiography. Bones were examined in animals sacrificed from 30 min to 49 days after injection. Quantitative autoradiography afforded more precise data than radiochemistry. It was found that the higher level of activity in the vertebral trabecular bone has also a significantly greater variability in activity distribution than that in the femoral trabecular bone in distal metaphysis. The data were used for dose determination in femur and vertebrae, especially in the epiphyseal plates and in the trabecular and compact bone. (auth)

30353 BODY ACCUMULATION OF ^{210}Pb AND ^{210}Po IN RATS AFTER ^{222}Rn INHALATION. Racoveanu, N.; Toader, M.; Ciubotaru-Bordeianu, A.; Rotaru, G. (Inst. of Hygiene and Public Health, Bucharest). pp 235-238 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Bronchial carcinoma in uranium miners was attributed to irradiation delivered by the short-life ^{222}Rn daughter products (RaA → RaC') to bronchial epithelium. The irradiation due to these products is limited on the time the miners are inhaling ^{222}Rn. Observations made by many authors have shown that ^{222}Rn long-life daughter products, especially ^{210}Po and ^{210}Pb, persist in human and animal organisms months and years after inhalation. Obviously, such a fact is understandable and the idea that urinary excretion of ^{210}Po and ^{210}Pb may be a way for the assessment of bronchial exposure seems reasonable. Previous histoautoradiographic observations have demonstrated the persistence of bronchial storages of long-life ^{222}Rn daughter products and from this finding we resumed our study on the dynamics of the phenomenon. (auth)

30354 METABOLISM OF INHALED ^{147}Pm-CONTAINING LUMINOUS MASSES AND REMOVAL OF RADIOACTIVE MATERIALS. Gensicke, F.; Hoelzer, F.; Nitschke, H. W. (National Centre for Radiation Protection, Berlin). pp 245-248 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The metabolism of ^{147}Pm in mice was examined after single inhalation or oral application of ^{147}Pm-containing luminous mass. After inhalation there are no essential differences in the tissue distribution and excretion of ^{147}Pm between the two different luminous compounds. Besides in the lung, ^{147}Pm was found mainly in the liver and the skeleton. The behavior of ^{147}Pm of both luminous paints in the lung can be described by a multiterm exponential function. After treatment with hexametaphosphate (HMP), calcium-Weiss (commercial EDTA preparation) or diethylenetriaminepentaacetic acid (DTPA), the retention of ^{147}Pm in the whole body is decreased. The effect of DTPA and calcium-Weiss is more effective than HMP. (auth)

30355 COMPARISON OF ^{137}Cs AND ^{42}K TRANSPORT OF RAT ERYTHROCYTES BY MEANS OF A TRACER KINETIC MODEL. Gyoergyi, S.; Kanyar, B. (Inst. of Biophysics, Budapest). pp 263-268 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). CONF-720503-.

The mechanism of Cs^{+} ion transport of rat erythrocytes was investigated by comparing the parameters characteristic of ^{42}K and ^{137}Cs transport. A three compartment linear tracer kinetic model

was used for the evaluation of experimental results. The comparison of the four transfer coefficients and the effect of ouabain on ^{42}K and ^{137}Cs uptake revealed a similar character in the transport of K^+ and Cs^+, however, the influx of the two ions were different and a higher Cs/K ratio developed in the membrane. Based on this similarity the elimination of radioactive cesium from tissues was accelerated by means of increasing the K^+ turnover. (auth)

30356 STUDY OF THE METABOLIC PROCESSES INDUCED BY SOME RADIOPHARMACEUTICALS IN SMALL ANIMALS. Kocsar, L.; Farkas, G.; Kutas, V.; Varteresz, V. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 275-281 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The application of radiopharmaceuticals in medical diagnostics involves unwanted exposure to the patients. To reduce exposure, incidental to the various examinations, new radioactive pharmaceuticals with advantageous biological and physical properties are put on the market. To establish the absorbed dose values, the metabolic processes induced by these new preparations were studied. Besides, the accumulation ratios in the various organs were determined on small animals and computations were done as to the exposure level to be expected in human diagnostics. The problems connected with projecting of new radioactive drugs are discussed within the above scope. The new preparations tested were iodine-125-labeled Fibrinogen, Gordox, and Streptase. (auth)

30357 POLYAMINEPOLYALKYLPHOSPHONIC ACIDS AS EFFECTIVE LIGANDS FOR BINDING AND ELIMINATING URANIUM AND ITS FISSION PRODUCTS FROM THE BODY. Balabukha, V. S.; Ivannikov, A. T.; Razbitnaya, L. I.; Razumovskii, N. O.; Tikhonova, L. I.; Baranovskaya, L. M. (Inst. of Biophysics Moscow). pp 293-298 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Chelating processes of various aminealkylphosphonic acids with uranium and ^{45}Ca, ^{91}Y, ^{144}Ce, ^{95}Zr, ^{95}Nb, and ^{106}Ru radionuclides were studied by the methods of spectrometry, electrophoresis, potentiometry, and ion exchange. It was established that the stability of the complex compounds with uranium, ^{95}Zr, ^{95}Nb, and ^{106}Ru is higher than that of complexonats while the stability of compounds with ^{91}Y, ^{144}Ce, and particularly with ^{45}Ca is lower. All compounds tested on dogs and rats were proved to be efficient in accelerating elimination and decreasing deposition of ^{95}Zr, ^{95}Nb, and particularly of uranium. They provide for animal survival and reduce the deleterious effect of uranium on kidneys and on animal as a whole. For the elimination of ^{91}Y and ^{144}Ce, these acids are inferior to the appropriate complexonats. (auth)

30358 MINERAL SORBENTS USED AS ANTIDOTES IN CASE OF RADIOSTRONTIUM AND RADIOCESIUM INTOXICATION. Borisov, V. P.; Ilyin, L. A.; Kendysh, M. M.; Shomorokhova, T. N.; Mikhailovich, S. M.; Seletskaya, L. I. (Inst. of Biophysics, Moscow). pp 299-302 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Results of experiments with selective mineral sorbents used for reduction of radionuclide resorption from intestine are presented. Experiments were performed on test animals (dogs, rats). In the case of radiostrontium intoxication the preparation of barium sulphate with developed adsorption surface (adsobar) proved to be 5 to 10 times more efficient than common barium sulphate used in medical practice for roentgenoscopy. Ion-exchangers on the basis of antimony polymerides appeared to be still more efficient (resorption reduced by 90 to 95%) when used in small doses. Ferrocyanides of ferrum (Berlin blue), cobalt, nickel, and copper appeared to provide for decreasing radiocesium deposition in tissues and organs by 95 to 99%. Ferrocyanides of zinc and cadmium proved to be of little effect when applied to living organism. The fact that factory preparations of Berlin blue (Milori preparations) synthesized by indirect method have a weak sorption effect was established. (auth)

30359 DECORPORATION EXPERIMENTS ON STRONTIUM INTOXICATION IN RATS. Mate, L. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest); Varga, L.; Varteresz, V.; Feher, I. pp 307-311 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The effects of ionizing radiations, radioprotectors, and sodium alginate on the retention of perorally administered Sr were studied on x-irradiated rats. The increase in retention following irradiation with 300 R could be prevented by radioprotectors. If given perorally prior to or intravenously after Sr administration radioprotectors also reduced retention. This deposition-reducing effect of radioprotectors is attributed to the blocking of Sr transport proteins. Depending on its composition, sodium alginate was also capable of reducing retention in irradiated animals. (auth)

30360 CHANGES OF PASSAGE AND ABSORPTION OF RADIOSTRONTIUM IN THE GASTROINTESTINAL TRACT OF IRRADIATED RATS. Vondracek, V.; Hradil, J. (Purkyne Medical Research and Postgraduate Inst., Hradec Kralove, Czech). pp 313-315 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The effect of gamma irradiation (500 R) on the passage and absorption of $^{85}SrCl_2$ in the gastrointestinal tract of male albino rats was studied. Using the system of compartment analysis and simulation, a method was developed for the simultaneous determination of intestinal passage and absorption. The percentage absorption of ^{85}Sr was determined also from the values of whole-body retention and excretion. The emptying half-time of ^{85}Sr from the stomach and the transit half-times in segments of the small intestine are longer in irradiated rats than in the controls. The percentage absorption of ^{85}Sr in irradiated rats was increased. (auth)

30361 EXPERIMENTAL RESEARCH ON THE TREATMENT OF CONTAMINATION BY ACTINIDE SOLUTIONS. Morin, M.; Skupinski, W.; Nenot, J. C.; Lafuma, J. (French Atomic Energy Commission, Fontenay-aux-Roses). pp 317-320 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

DTPA therapy must be initiated only if chelation of the isotope is possible. DTPA proved to be effective mostly on the removal of elements of valence III (Am, Cm, Cf). DTPA was quite as effective on ^{238}Pu, but its effectiveness on ^{239}Pu was more difficult to appreciate because of the much slower migration of this isotope. DTPA therapy proved to be uneffective on U, Pa, and Np contaminations. Its renal toxicity makes DTPA especially dangerous in the treatment of U intoxication. (auth)

30362 DTPA THERAPY IN THE MONKEY OF LUNG INTERNAL EXPOSURES TO LANTHANUM: EFFECT OF THERAPEUTIC DELAYS AND ROUTES OF ADMINISTRATION ON TREATMENT EFFECTIVENESS. Ducousso, R.; De Regnaud, M.; Perrault, G.; Pasquier, C. (Army Health Service Research Group, Fontenay-aux-Roses, France). pp 321-325 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Macacus monkeys were delivered a constant lung burden of $^{140}LaCl_3$ and treated by DTPA administered as aerosol, intravenously, or by slow perfusion at times ranging from 0 to 24 hrs following contamination. Therapy was all the more effective as the delay was shorter, and aerosol was the most effective route. (auth)

30363 ZIRCONIUM COMPOUNDS IN THE THERAPY OF INTERNAL CONTAMINATION. Severa, J. (Purkyne Medical Research and Postgraduate Inst., Hradec Kralove, Czech.). pp 327-330 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The elimination effect of various soluble and insoluble zirconium compounds after internal contamination of ^{85}Sr and ^{144}Ce was investigated in rats. Experiments were also performed on decreasing the absorption of radionuclides in the gastrointestinal tract (GIT). All the investigated soluble zirconium compounds decreased the retention of ^{144}Ce in liver and femurs but have no significant effect on the elimination of ^{85}Sr from femurs and tibias. The most effective compounds are semicrystalline zirconium phosphate and zirconium citrate decreasing the absorption of ^{144}Ce and ^{85}Sr in GIT, respectively. (auth)

30364 INFLUENCE OF DECONTAMINATION TREATMENT OF SKIN CONTAMINATED WITH RADIONUCLIDES ON THE

DEGREE OF INTERNAL CONTAMINATION. Stojanovic, D.; Milivojevic, K. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). pp 331-334 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The absorption of ^{137}Cs, ^{85}Sr, and ^{95}Zr through the skin under the influence of some physical and chemical factors that could determine permeability variations was studied. In the study of internal contamination induced by percutaneous way, the influence of cleansing procedures and agents for decontamination on the absorption was observed. The results have shown that the most efficient agent for decontamination is the detergent "Badd" which decreases the residual radioactivity in the contaminated part of the skin. Protective cream "Octa" markably reduces radionuclide absorption and increases decontamination efficiency. The decontamination in the cases of contaminated skin can be the same. (auth)

30365 REDISTRIBUTION OF DOSES OF INTERNAL RADIATION IN THE ORGANISM AS A RESULT OF PROTECTIVE PREPARATION APPLICATION. Danetskaya, E. V.; Ibatullin, M. S.; Korzun, V. N.; Ramzaev, P. V.; Shakalova, V. V. (Inst. of Radiation Hygiene, Leningrad). pp 349-352 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Application of some protection preparations binding radioactive isotopes in the intestinal tract, results in the redistribution of ingested doses of radiation. For instance, administration of Prussian blue reduces ^{137}Cs dosage in the organism, raising the dose in the colon simultaneously. The findings of the experiments on rats suggest that in spite of the increase of dosage in the intestine, the administration of isotope-binding substances offers certain advantages. (auth)

30366 MECHANISM OF LIVER UPTAKE OF LANTHANIDES. Slouka, V. (Inst. of Hygiene and Epidemiology, Prague). pp 357-360 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

Several factors influencing the rate and level of retention of ^{141}Ce, ^{152}Eu, and ^{175}Yb were studied in isolated perfused rat liver: the effect of pH, isotopic carrier, stimulation of liver RES by glucan, blockade with colloidal carbon or isotopic carrier, toxic effect of carbon tetrachloride, and the effect of DTPA administered in different time intervals. The results have shown that monomeric as well as polymeric forms of lanthanides are taken up predominantly in hepatocytes. This finding is in contradiction with the generally accepted view on Kupffer cells as the main structure retaining polymeric forms of hepatotropic radionuclides. These results were confirmed in experiments in vivo as well. (auth)

30367 THOROTRAST DISTRIBUTION IN DOGS FOLLOWING SPINAL INJECTION. Molla, M. A. R.; McNeill, K. G.; Harrison, J. E. (Univ. of Toronto, Ont.). pp 477-479 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A study was made of the fate of thorium and its daughters after the intraspinal injection of thorotrast into dogs. It is shown that a high but variable fraction of the radioactive material is lost from the CNS within 1 day of injection. Excretion rates following IS injection are similar to those following IV injection. The highest specific activities are found in the caude equina. Dose calculations show that with humans, after thorotrast myelography the dose to the cauda equina over 10 yrs may be tens of kilorems. (auth)

30368 ANALYSIS OF GAMMA SPECTRA OF ^{226}Ra OR ^{224}Ra IN NON-EQUILIBRIUM WITH THEIR DECAY PRODUCTS. Thomas, J.; Roth, Z.; Malatova, L; Lenger, V. (Inst. of Hygiene and Epidemiology, Prague). pp 481-484 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

A method of scintillation gamma spectrometry is described for the analysis of a mixture of emitters forming radioactive series based on the measurement of the time course of the spectrum in non-equilibrium supplemented by a single measurement of the spectrum in equilibrium. The method requires no special calibration for all gamma emitters of the series and consists of a multidimensional non-linear regression analysis of the time course of the spectrum. The method has proved to be satisfactory for the measurement of small biologic samples with ^{224}Ra or ^{226}Ra in any state of non-equilibrium with their decay products and for the determination of ^{226}Ra in mouse in vivo. (auth)

30369 ROLES OF SELENIUM IN NEURAL PHYSIOLOGY OF AVIAN SPECIES. 2. The Distribution of ^{75}Se from Injected Selenomenthionine-^{75}Se in the Tissues and its Fate in Livers of Chickens. Vohra, P. (Univ. of California, Davis); Johnson, C. M.; McFarland, L. Z.; Siopes, T. D.; Wilson, W. O.; Winget, C. M. Poultry Sci.; 52: 644-647(Mar 1973).

Both male and female chickens were injected with a dose of selenomenthionine-^{75}Se two hours before killing and the total selenium and the radioactivity in various tissues were determined. For the sexes the tissues can be ranked as follows for total selenium content/gm. fresh tissue: (males) pituitary, pineal, adrenals, kidneys, liver, spleen, pancreas, retina, diencephalon, blood, cerebrum, testes, cerebellum and pectoral muscle; (females) pituitary, pineal, adrenals, kidneys, diencephalon, spleen, pancreas, liver, oviduct, cerebellum, ovary, cerebrum, pectoral muscle and blood. The specific activity of ^{75}Se was highest in testes, pancreas, liver, kidneys and spleen of males; and pancreas, oviduct, blood, kidneys and liver of females. About 82% of the radioactivity was associated with a T. C. A. insoluble fraction in liver. (auth)

30370 UPTAKE OF MATERIALS BY THE INTACT LIVER. Concentrative Transport of Rubidium-86. Goresky, C. A.; Bach, G. G.; Nadeau, B. E. (McGill Univ., Montreal). J. Clin. Invest.; 52: 975-990(May 1973).

The multiple indicator dilution technique was used to outline the kinetic mechanisms underlying the uptake of rubidium, a cation which, in the steady state, is concentrated by hepatic parenchymal cells. A mixture of ^{51}Cr-labeled red blood cells (a vascular reference substance), ^{22}Na (which is confined to the extracellular space, the expected extravascular distribution space for rubidium, in the absence of cellular uptake), and ^{86}Rb was injected into the portal vein and normalized outflow patterns, expressed as outflowing fractions of each injected mass per milliliter vs. time, were obtained. The labeled red cell curve rose to the highest and earliest peak and decays rapidly. That for labeled sodium rose to a later and lower peak, and decayed less rapidly. Its extrapolated recovery is equal to that for the red cells. The observed ^{86}Rb curve consists of two parts: an early clearly defined peak of reduced area, related to the ^{22}Na peak in timing; and a later tailing, obscured by recirculation, so that total outflow recovery cannot be defined (even though it would be expected to be the same). Two corresponding outflow fractions of ^{86}Rb were found: throughput material, which sweeps past the cell surface as a wave delayed with respect to the vascular reference (tracer which has not entered cells); and exchanging material (tracer which has entered cells and later returns to the circulation). The outflow form of the rubidium curve, the presence of both a relatively clearly defined throughput component, and a relatively prolonged low-in-magnitude tailing, is consequent to the concentrative character of the transport mechanism, to the presence of an influx rate constant many times the efflux rate constant. The modeling has potential application in situations where transport is nonconcentrative. (auth)

30371 ^{85}Sr AND ^{45}Ca ABSORPTION AND INTESTINAL MITOCHONDRIA UPTAKE AFTER PERFUSION WITH CALCIUM AND STRONTIUM. Mraz, F. R. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. Poultry Sci.; 51: 2065-2068(Nov 1972).

The small intestine of White Leghorn hens and pullets was perfused with solutions containing 0, 5, 25, or 125, mM. Ca or Sr and some additional hens were perfused with 2.5, 12.5, or 62.5 mM. Ca and Sr calcium 45 and ^{85}Sr were added to part of the perfusate at tracer levels. The chickens were sacrificed immediately after perfusion and ^{45}Ca and ^{85}Sr contents of the mucosal mitochondria from three sections of the small intestine determined. More ^{45}Ca was absorbed than ^{85}Sr, the differences being influenced by the level and kind of alkaline earth in the perfusate. Increasing the alkaline earths decreased ^{85}Sr and ^{45}Ca absorption with Sr, alone, being less effective. The 125 mM. level of Ca or Sr or their combination, generally reduced the mitochondrial content of these radionuclides. At the 125 mM. Ca levels and with the Ca and Sr combinations the mitochondria from the last third of the small intestine usually had more ^{85}Sr and ^{45}Ca than the other two thirds. (auth)

30372 UPTAKE OF RADIOACTIVE SULPHATE BY CHICK EMBRYONIC LIMB-BONE RUDIMENTS. Chokshi, H. R. (M. S. Univ. of Baroda, India). Indian J. Biochem. Biophys.; 9: No. 2, 138-140(1972).

In order to determine the effect of protein on the incorporation

of radioactive sulfate into mucopolysaccharides, limb-bond rudiments of 10-day-old chick embryos were grown in medium BGJ with and without added crystalline bovine plasma albumin. The uptake of labelled sulphate and its incorporation into mucopolysaccharide were stimulated when protein was added to the medium. When the bones grown previously in isotope containing medium were further grown in the isotope-free medium containing protein, a large amount of radioactivity was released into the medium. The possible mechanism of the stimulation by protein is discussed. (Indian Sci. Abstr.)

30373 RAPID ELIMINATION OF BARIUM-137m FROM GUINEA PIG HEART MUSCLE CELLS. Edelmann, L.; Edelmann, H. (Univ. of Saarland, Homburg, Ger.). Biophysik; 10: No. 1, 99-101(1973).

Experiments concerning the disturbance of the ^{137}Cs to ^{137m}Ba equilibrium in muscle cells were performed with perfused guinea-pig hearts. It could be calculated that ^{137m}Ba is eliminated with a half-life of about 17 sec from the heart muscle cells into the coronary venous effluent. (auth)

30374 SOME EFFECTS OF LIFETIME PARENTAL EXPOSURE TO LOW LEVELS OF TRITIUM ON THE F_2 GENERATION. Laskey, J. W.; Parrish, J. L.; Cahill, D. F. (National Environmental Research Center, Research Triangle Park, NC). Radiat. Res.; 56: No. 1, 171-179(Oct 1973).

Rats were continuously exposed to constant activities of tritium (HTO) in drinking water from conception of the F_1 generation through delivery of the F_2. The activities employed were 0.01, 0.10, 1.0, and 10.0 μCi HTO/ml of body water, which are 2 to 2000 times the MPC_w for an individual in the general population. These activities provided whole-body dose rates of approximately 3 to 3000 mrads/day. Continuous exposure at 10 μCi/ml produced a 30% reduction in the weight of F_1 adult male testes but no impairment of growth or reproductive ability. Statistically significant effects on the F_2 neonates were: reductions in relative brain weight at 0.1 to 10.0 μCi/ml; decreased body weight at 1.0 and 10.0 μCi/ml; decreased litter size and increased resorption at 10.0 μCi/ml. Analyses of the metabolically incorporated tritium activities of F_1 adult male and F_2 neonatal tissues were performed. The results indicate that maximum tritium levels in tissue from HTO are reached during in utero exposure. Brain and testes contained approximately 100 and 50% greater tritium activities, respectively, than the average in other tissues. Comparisons were made with a similar study that employed only intrauterine HTO exposures. These indicate that lifetime parental exposure to low levels of radiation produces effects on the F_2 at levels 10 to 100 times below those required for effect after in utero exposure alone. (auth)

30375 PASSAGE OF ^{85}Sr AND ^{47}Ca INTO THE GASTROINTESTINAL TRACT IN RATS DURING FEEDING AND FASTING. Warren, J. M.; Spencer, H. (Veterans Administration Hospital, Hines, IL). Contract AT(11-1)-1231-83. Radiat. Res.; 56: No. 1, 110-121(Oct 1973).

The secretion of ^{85}Sr and ^{47}Ca from the vascular space into the intestine was determined in rats as a function of time during both feeding and fasting. ^{85}Sr and ^{47}Ca were injected intravenously, and the rats were sacrificed after ½, 1, 2, 4, and 24 hours. The gastrointestinal radioisotope content was measured in six separate segments. During feeding, slightly more ^{47}Ca than ^{85}Sr, 5.1 vs 4.6% of the dose, respectively, was present at ½ hour in the gastrointestinal tract. At 4 hours the ^{85}Sr in the intestine rose to 7.0%, while ^{47}Ca had increased only very slightly. Between 4 and 24 hours the excretion of both isotopes via the intestine increased, but the increase in ^{85}Sr excretion was greater than that of ^{47}Ca, the values being 11 and 8.6% of the dose at 24 hours, respectively. Fasting decreased the secretion of both isotopes into the intestine at all time intervals, and this effect was more marked for ^{47}Ca than for ^{85}Sr. At 24 hours, during fasting, the intestinal excretion of ^{85}Sr was less than half of the feeding level, while the intestinal excretion of ^{47}Ca was less than one-third of that during feeding, resulting in a $^{85}Sr/^{47}Ca$ ratio of 2.0 during fasting vs 1.3 during feeding. (auth)

Plants

30376 (CONF-710501-P2, pp 929-935) MODELS OF MATTER FLOW IN A SOUTHERN MIXED HARDWOOD FOREST IN FLORIDA: PRELIMINARY RESULTS. Lugo, A. R.; Snedaker, S. C.; Gamble, J. F. (Univ. of Florida, Gainesville). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The southern mixed hardwood forest is the most diverse forest ecosystem in north central Florida, with a reported 36 tree species per thousand individuals. Although the floristic composition and climax-successional status are adequately known, little information is available on the flows and storages of energy and matter. This work is part of a larger study to trace the peculiar movement of ^{137}Cs into the food chains leading to man in Florida. This objective is being approached by computer modeling and simulation of the energy and matter dynamics. A qualitative model for the mineral cycles of the southern mixed hardwood forest is presented for ten elements within the major storage compartments (leaves, wood, roots, litter, and mineral soil), precipitation throughfall, and 18-month records of litter fall and accumulation. Seasonal pulsing is quantitatively described with respect to its relationship to ecosystem function. Preliminary results indicate a steady-state system with closed mineral cycling. The implications of steady systems, relative to ^{137}Cs movement, in Florida are discussed. (auth)

30377 (LURI-1972-8) ^{137}Cs IN THE REINDEER LICHEN CLADONIA ALPESTRIS; DEPOSITION, RETENTION AND INTERNAL DISTRIBUTION, 1961–1970. Mattsson, L. J. S. (Lund Univ. (Sweden). Dept. of Radiation Physics). Aug 1972. 50p. Dep. NTIS (U.S. Sales Only) $4.50.

The accumulation of the fallout radionuclide ^{137}Cs was studied in a large number of samples of the important reindeer-lichen Cladonia alpestris, collected in the Lake Rogen area (62.3°N, 12.4°E) in central Sweden during the period 1961 to 1970. The maximum area-content of ^{137}Cs in the lichen-carpet occurred in 1965 and 1966, and amounted to 46 to 66 nCi m^{-2}, which corresponds to a dry-mass content of 34 to 52 NCi kg^{-1}. In September, 1970, the ^{137}Cs levels for the whole lichen-carpet were 50 to 80% of the values obtained in 1965. The vertical distribution of ^{137}Cs was studied during 1966 to 1970, and the results indicate the existence of a short-time internal cycling of the radionuclide in the lichen-carpet, so that in dry periods certain amounts of ^{137}Cs are forced up to the top regions of the carpet, and in periods of high precipitation washed down to its lower layers. The concentration of ^{137}Cs at various depths recorded in carefully field-fractionated samples of lichen, gelatinous matter, humus, and soil collected in the normal years 1969 and 1970 follows the empirically found relation: $c = \text{constant} \cdot \exp(-1.6\, z^{0.75})$, where c denotes the ^{137}Cs-concentration in dry matter (nCi kg^{-1}) at the dry mass depth z (kg m^{-2}). For comparison with the ^{137}Cs-results, the vertical distribution of two other alkali metals, potassium and sodium have also been studied. According to increasing penetration of the lichen-carpet, the elements can be arranged in the following sequence: $^{137}Cs \sim K \ll Na$. Indications of the presence of undissolved particles of radioactive fallout in the lichen-carpet are presented and discussed. The principal ways for elimination of ^{137}Cs from undisturbed carpets of Cladonia alpestris are physical decay of the radionuclide and the continuous growth of the lichen plants, the latter combined with a continuous decomposition of older material. (auth)

30378 ECOLOGICAL INVESTIGATION OF THE BEHAVIOR OF ^{55}Fe IN PLANTS, ESPECIALLY LICHEN, AND IN THE MEAT OF CATTLE AND GAME. Barwinek, F. Munich; Univ. Munich (1972). 146p. (In German).

Thesis.

Ninety-eight lichen samples, collected between 1965 and 1970, among them 69 from the GFR and 15 from Finland, mainly of the genus Cladonia, 5 moss, 2 heather, and 4 hay samples as well as samples of meat from 12 Bavarian cattle, slaughtered in Spring 1970, 7 stags, killed in the East Carpathians in Fall 1969, and one chamois, killed in the Niedere Tauern in Fall 1970 were analyzed with respect to their content of ^{55}Fe and stable iron. The ^{55}Fe contamination of lichen is determined mainly by the amount of atmospheric precipitation. From 1965 to 1969 it decreased more in areas receiving a high precipitation than in regions with little precipitation. The more efficient wash-out and leaching processes occurring in rainy areas are probably the reason for this behavior. The biological half-life of ^{55}Fe was 1.4 yrs, while the effective half-life is 0.9 yrs. In general, the ^{55}Fe activities of the lichen investigated showed from 1965 to 1970 a decreasing tendency with respect to time, in correspondence with the decreasing fallout activities. The contamination of the lichen obviously does not depend on the degree of latitude. The moss samples showed, in general, a higher ^{55}Fe contamination than lichen grown under identical conditions of precipitation and, furthermore, contained a higher amount of stable iron. Heather samples showed hardly any difference in their ^{55}Fe contamination, hay samples, on the other hand, showed a considerably different ^{55}Fe contamination than lichen. The ^{55}Fe contamination in meat samples of stag and of a chamois exceeded the ^{55}Fe contamination of beef by about a factor of four. It was not possible to find a correlation between the ^{55}Fe contamination of the environment and the meat in 1969/70. Probably such a correlation existed in the years from 1961/62, considering the correlation found between

the ^{55}Fe contamination of lichen and the long-term annual precipitation. (GE)

30379 EFFECT OF BETA IRRADIATION ON GROWTH AND YIELD OF A FIELD PEA CROP. Schulz, R. K.; Kantz, A. D.; Babcock, K. L. (Dept. of Soils and Plant Nutrition, Berkeley, CA). Radiat. Res.; 56: No. 1, 122-129(Oct 1973).

A field study was carried out in which a beta-emitting fallout simulant was applied to a 35-day-old pea crop. On deposition of the simulant, almost all of the material came to rest on the soil surface and not on the plant. A dosimetry system was developed for measurement of the beta dose received by the plants. The fallout simulant consisted of yttrium-90 fused on very fine sand. An application of 55 mCi/m^2 resulted in a surface dose of 1,690 rads to plant tissue in the region of the shoot meristems. This level of radiation reduced yield of peas to 39% of the control. Higher radiation levels reduced pea yield to zero, but 38,500 rads were required to materially reduce vegetative growth. Thus it was observed that reproductive tissue was much more sensitive to beta-radiation damage than was vegetative tissue. On the basis of theoretical calculations, it is suggested that the beta component in fallout may be more significant than the gamma component in adversely affecting the yield of a pea crop under the condition of this experiment. (auth)

New Tracer Techniques

Refer also to abstracts 29619, 29620, 29772, 29924, 29925, 30099, 30167, 30326, 30343, and 30371.

30380 (CONF-730321-, pp 107-117) EYE TUMOR IDENTIFICATION. Larose, J. H.; Palms, J. M.; Hagler, W. S. (Emory Univ., Atlanta). 1973.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

Semiconductor detectors in medicine.

The instrumentation, radiopharmaceuticals, and procedure for the ^{32}P eye tumor identification test are described. Patients are injected intravenously with 10 $\mu Ci/kg$ of ^{32}P as sodium phosphate up to a maximum of 700 μCi. The beta radiation is determined at 48 hr with a variety of instrumentation including G-M counters or Si(Li) detectors. Experience with the method is briefly discussed. (WHK)

30381 (CONF-730321-, pp 127-147) TECHNIQUES FOR IN-VITRO AND IN-VIVO ELEMENTAL QUANTITATION BY FLUORESCENT EXCITATION. Kaufman, L.; Wilson, C. J.; Nelson, J. A.; Shames, D. M. (Univ. of California, San Francisco). 1973.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

In semiconductor detectors in medicine.

X-ray fluorescent techniques for determination of stable element tracer concentrations in tissues and body fluids for medical studies are described. The quantitation of non-radioactive iodine and bromine tracers was studied, and techniques and results are discussed. (WHK)

30382 RADIOIMMUNOASSAY OF HUMAN CIRCULATORY DOPAMINE-β HYDROXYLASE. Ebstein, R. P.; Park, D. H.; Freedman, L. S.; Levitz, S. M.; Ohuchi, T.; Goldstein, M. (New York Univ., NY). Life Sci.; 13: No. 7, 769-774(1 Oct 1973).

A procedure for the radioimmunoassay of human circulatory dopamine-β-hydroxylase (DβH) using antibodies directed toward human DβH is described. A significant correlation between serum DβH activity and the amount of serum immunoreactive (IR) DβH was found in the analyzed population. The radioimmunoassay of serum DβH could be used in monitoring changes of sympathetic activity in various physiological and pathological states. (auth)

30383 DIAGNOSTIC USE OF IODINE-131 IN CHILDREN. Safety and Utility Compared to Other Tests. Treves, S.; Crigler, J. F. Jr. (Harvard Medical School, Boston). Pediatrics; 51: No. 5, 929-930(May 1973).

In view of a report of a case of thyroid carcinoma following pediatric diagnostic procedures using ^{131}I, the role of the use and the safety of ^{131}I thyroid uptake and scan in evaluation of disorders of the thyroid gland in children is reviewed. It is suggested that the availability of ^{123}I would reduce the hazards of thyroid studies in children. (ERB)

30384 CARDIAC CHANGES WITH ^{99m}Tc-TIN-PHOSPHATE RADIOPHARMACEUTICALS. Stevenson, J. S.; Dunson, G. L. (Armed Forces Radiobiology Research Inst., Bethesda, MD). J. Nucl. Med.; 14: No. 10, 774-775(Oct 1973).

The use of ^{99m}Tc-tin phosphonate complexes for bone scanning is discussed in relation to dose administered, chemical structure, administration method, and possible toxic effects in patients, especially those with severe cardiac abnormalities or extensive skeletal lesions. Rapid administration by intravenous injection into animals produced acute toxic symptoms at a dose of 30 mg/kg, and changes in the electrocardiogram were observed in dogs beginning at 20 mg/kg levels. A reply by Frank P. Castronovo, Jr. and Ronald J. Callahan states that when the diphosphonate molecule is used, rather than the pyro- or polyphosphate, a clinical dose of 0.5 mg/1.3 ml/patient produced no adverse effects during use for approximately 1,000 bone scans. (CH)

30385 COMPARISON OF ^{131}I, ^{99m}Tc, AND ^{113m}IN FOR LIVER SCANS. Raikar, U. R.; Ganatra, R. D. (Bhabha Atomic Research Centre, Bombay). J. Nucl. Med.; 14: No. 10, 763-764(Oct 1973).

The optimum base-level settings were derived experimentally from the line-spread function for the three radionuclides, ^{113m}In, ^{131}I, and ^{99m}Tc. The scans of liver slice phantom obtained with these radionuclides showed that the image quality and detectability of lesions were better with the optimum settings than with the conventional 100-keV window. Indium-113m appeared to be superior to the other radionuclides in its efficiency for detection of a lesion in a phantom. (auth)

30386 LUNG UPTAKE OF ^{99m}Tc-SULFUR COLLOID IN ORGAN TRANSPLANTATION. Klingensmith, W. C. III; Ryerson, T. W.; Corman, J. L. (Univ. of Colorado, Denver). J. Nucl. Med.; 14: No. 10, 757-759(Oct 1973).

Lung uptake of ^{99m}Tc-sulfur colloid is frequently seen in patients with liver transplants and has been reported in a patient with a spleen and bone marrow transplant. The absence of lung uptake in dogs with renal transplants suggests that lung uptake is not associated with transplantation in general. (auth)

30387 SEALED SOURCES OF ^{99m}Tc INSERTED INTO STANDARD BIOPSY NEEDLES AND CATHETERS: USE IN ANATOMIC LOCALIZATION BY EXTERNAL RADIONUCLIDE IMAGING. Green, J. P.; Ashburn, W. L.; Hurwitz, S. R.; Halpern, S. E. (Univ. of California, San Diego, La Jolla). J. Nucl. Med.; 14: No. 10, 743-746(Oct 1973).

For the purpose of anatomic localization, a variety of sealed sources containing ^{99m}Tc were constructed. These sources, when inserted into biopsy needles and imaged with a portable scintillation camera, served to direct the proper placement of those needles. Concomitant organ imaging was used to identify the target site for biopsy. Indwelling CVP and Swan-Ganz catheters filled with sterile sodium pertechnetate were localized against the mediastinal silhouette provided by a flooded field transmission source placed behind the patient. Larger diameter catheters containing sealed sources within their lumens were similarly imaged. These techniques have proven to be clinically useful. (auth)

30388 REGIONAL PULMONARY FUNCTION STUDY USING ^{133}Xe. Maeda, T. (Kobe Univ., Japan); Matsumoto, A.; Matsuo, M.; Narabayashi, I.; Nakao, N. Radioisotopes (Tokyo); 22: No. 3, 124-130(Mar 1973).

The regional pulmonary function study was carried out using ^{133}Xe. The spot sampling method with two or more scintillation probes and the dynamic study method using scintillation-camera computer on line system were used. The ^{133}Xe wash-out curve was measured in the regional lung area under both methods. To use the combination of the ^{133}Xe ventilation scan and the perfusion scan with ^{131}I-MAA made the patho-physiological analysis of the pulmonary function easier. It was found that the analysis of regional pulmonary function change is as necessary as the analysis of regional pulmonary anatomical change, which is performed with information from chest x-ray film. Both together provide much more information in evaluating the clinical state of pulmonary disease in details. (auth)

30389 LIVER AND SPLEEN SCINTIGRAPHY BY ^{131}I-MICRO-AGGREGATED ALBUMIN (^{131}I-MIAA). Tatsuno, I.; Kato, S. (National Hospital of Kanazawa, Japan). Radioisotopes (Tokyo); 22: No. 2, 72-78(Feb 1973). (In Japanese).

Iodine-131-MIAA (Daiichi Radioisotope Labs., Ltd., particle size: 1 to 3 ω was compared with ^{198}Au-colloid using liver and spleen scintigraphy. The disappearance of ^{131}I-MIAA was 2.5 hrs in the liver and 3.5 hrs in the spleen. Suitable time of scintigraphy was from 10 min to 1 hr after intravenous injection. The radiation dose with ^{131}I-MIAA to liver was decreased to 1/40 of that with ^{198}Au-colloid and ^{131}I-MIAA was more localized to spleen in hepatosplenopathy. Therefore, it is more useful for the reagent of scintigraphy for spleen than ^{51}Cr of ^{203}Hg-MHP, considering radiation dose to spleen and kidney. The radioisotope accumulation ratio in spleen and liver calculated with ^{131}I-MIAA showed more separative values than that with ^{198}Au-colloid, so it seemed to be valuable for diagnosis and estimation of disease. (auth)

30390 THYROID ^{131}I UPTAKE MEASUREMENT WITH A SCINTILLATION CAMERA. Saegusa, K.; Kakehi, H. (Chiba Univ., Japan). Radioisotopes (Tokyo); 22: No. 2, 79-83(Feb 1973).

In thyroid scintigraphy, if the thyroid ^{131}I uptake measurement could be made simultaneously with the scintigram of the thyroid gland using a pinhole scinticamera, it would be very convenient. However, the problem is whether correct results can be obtained or not. Results of experiments were compared with the routine thyroid uptake tests (ORINS technique). The values of uptake were in general low compared with the ORINS technique, when a point source like a capsule was used as a standard source. It is recommended that the thyroid ^{131}I uptake measurement be made separately from the scintigraphy by 20 to 25 cm distance method, or by using a standard source similar to a patient's thyroid. (auth)

30391 QUANTITATIVE ANALYSIS OF THE DYNAMICS OF THE CENTRAL CIRCULATION SYSTEM USING SCINTILLATION CAMERA. With Special Reference to the Calculation of the Cardiopulmonary Volume and the Left-to-Right Shunt Rate by Analog Analysis. Konishi, Y. (Kyoto Univ.); Higasa, Y.; Ishii, Y.; Mukai, T.; Mori, T. Shinzo; 4: No. 10, 1269-1283(Oct 1972). (In Japanese).

Using a scintillation camera connected with a 1600 word memory and magnetic tape the dilution curves of each chamber of the heart and the lungs were obtained. The volume of each chamber and the left-to-right shunt were then calculated from the analog simulation of the dilution curves. About 5 mCi of ^{99m}Tc-albumin was rapidly injected into the cubital vein of the patient in the slight oblique position of about 30 degrees. Pictures of the anterior chest were recorded by the scintillation camera every 0.6 second and were collected in the magnetic tape after being transformed from count volume to a digital volume of 40 × 40. When about 5 mCi of ^{99m}Tc-pertechnetate was injected into the circulation system model, the error was about 10% compared with the actual volume. Following problems should be considered for the clinical application of the analog analysis method: stability of ^{99m}Tc-albumin in the living body, condition of the injection of RI, determining the position of a patient to select the region of interest, and possibility of misreading radiation doses when large amounts of RI are used. (JA)

30392 SCINTISCANNING OF THE ADRENAL GLAND WITH ^{131}I-19-CHOLESTEROL. Fukuchi, S. (Tohoku Univ., Sendai); Takenouchi, T.; Nakajima, K.; Nakamura, M.; Nitta, K.; Nippon Iji Shimpo; No. 2531, 29-33(Oct 1972). (In Japanese).

Iodine-131-19-cholesterol with specific activity of 0.4 to 1.2 mCi/mg was injected intravenously to seven cases of primary aldosteronism, two cases of Cushing's disease, and two cases of essential hypertension with normal function of the adrenal gland in a dose of 1 mCi/50 kg body weight and scintigram of the adrenal gland was made 5 to 9 days after injection. Scintiscanning was also performed after 2 mg/day of dexamethasone injection to two cases of primary aldosteronism and one case of essential hypertension. The clear picture of tumor in the adrenal gland was obtained in three of the seven cases of primary aldosteronism and one of the two cases of Cushing's disease. An optimal scan was obtained 8 days after injection. The diameter of the adenoma was 10 mm at shortest, or clear scans could not be made. When dexamethasone was given to the case of primary aldosteronism, a shadow of the adrenal gland on the other side of the adenoma disappeared, but the shadow on the side of the adenoma remained unchanged. In the case of essential hypertension, a shadow that was likely to be adrenal adenoma disappeared. The radioactivity of administered ^{131}I-19-cholesterol excreted into the urine and feces was determined and the radioactive substances excised from the adrenal adenoma in one case of primary aldosteronism were analyzed. In the tissues of the adrenal adenoma the radioactivity was detected to be 115 times the concentration in the blood. In the adrenal adenoma and feces, the radioactivity was concentrated in the form of ^{131}I-19-cholesterol or its ester. In the urine, it seemed that the radioactivity was not present in the metabolised substances of steroid but present in inorganic iodides. The biological half-life of ^{131}I-19-cholesterol was shorter than 2 days. (JA)

30393 MECHANISM OF RI RETENTION IN TUMOR SCINTISCANNING WITH ^{67}Ga-CITRATE, ^{169}Yb-CITRATE, AND ^{51}Cr-BLEOMYCIN. Orii, H. (National Cancer Center, Tokyo). Rinsho Hoshasen; 18: No. 3, 211-212(Mar 1973). (In Japanese).

No significant relationship was found between uptake of ^{67}Ga and cell proliferation in the experimental neoplasms examined by the use of ^{67}Ga-citrate. In vitro, mouse blood serum was labeled with ^{67}Ga-citrate and $^{59}FeCl_3$ (double labeling) and fractioned by Sephadex G-200. Gallium was found to be binding with transferrin. Tumor affinity of ^{51}Cr, ^{59}Fe, ^{85}Sr, ^{203}Hg, ^{67}Ga, ^{169}Yb, $^{32}PO_4$, and $^{99m}TcO_4$ and adsorption rate were investigated in vitro. No difference was found between tumor affinity RI and non-affinity RI in adsorption rate to hydroxyapatite. One hour after intravenous injection of 200 μCi of ^{51}Cr-Bleomycin to the tumor bearing rabbit, positive delineation was observed by both scinticamera and scintigraphy. With use of $^{51}CrCl_3$, a slight positive image was obtained by scinticamera, but negative by scintigraphy. In the Ehrlich tumor bearing mouse, higher retention of radioactivity was observed in the tumor lesion and skeletal region, with the use of ^{51}Cr-Bleomycin. With $^{51}CrCl_3$, the radioactivity in the tumor lesion was almost the same level as other organs. (JA)

30394 MEASUREMENT OF LOW RADIOACTIVITIES IN METABOLIC STUDIES. Klein, W. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Birlinghoven, Ger.). pp 814-821 of Methodicum Chimicum. Vol. 1. Korte, F. Stuttgart; Thieme (1973). (In German).

A survey is given on counting techniques and detectors for low energy β-emitters: 1) autoradiography; 2) fluorography (scintillation autography); 3) flow counters (GM or proportional range); 4) automatic scanners (flow counters) for the evaluation of paper and thin-layer chromatograms; and 5) scintillation counters mainly liquid scintillation counters (evaluation of paper and thin-layer chromatograms, radiogas chromatography, flow scintillation techniques). (GE)

30395 TECHNETIUM-99m-LABELED PYROPHOSPHATE. A Simple and Reproducible Bone Scanning Agent. Hosain, P. (Johns Hopkins Medical Institution, Baltimore). Brit. J. Radiol.; 46: No. 549, 724-728(Sep 1973).

A simple method for the preparation of ^{99m}Tc-pyrophosphate was developed. A 1% solution of sodium pyrophosphate in isotonic saline was added to a 1% solution of stannous chloride in $\frac{1}{3}$ N HCl in 10:1 ratio, pH automatically adjusted to 5. An adequate amount of $^{99m}TcO_4$-eluate was added to 1 ml. of this mixture for bone scanning. Tissue distribution studies in mice showed rapid accumulation of the radiopharmaceutical in the bone. A higher value of the two-hour ratio of femur to liver specific activity was found suitable for the comparative evaluation of pyrophosphate preparations. Over 90% of the radioactivity cleared from the blood in 30 min in dogs, and the urinary excretion was about 40% in two hours. Serial scans in dogs showed an optimal visualization of the skeleton at about three hours. Good bone scans of adult patients were obtained in three to four hours using a tracer dose of the present radiopharmaceutical containing 5 to 10 mCi of ^{99m}Tc along with 2 to 6 mg of pyrosphosphate and 0.1 to 0.3 mg of tin. (UK)

30396 PENETRATION OF VARIOUS LABELLED STEROIDS IN HUMAN SKIN. Zesch, A.; Schaefer, H. (Freie Univ., Berlin). Arzneim.-Forsch.; 23: No. 3, 415-419(1973). (In German).

The penetration into human skin was studied for four steroids, hydrocortisone, fluoroformylone, 4-chlorotestosterone-acetate, and fluocinolone-acetonide-acetate from the same ointment base, in each case. In the in vitro and comparable in vivo experiments, percentual data about the distribution of the substances from vaseline base for the three skin layers were obtained by employing various periods of penetration (10 to 1,000 min). The largest quantity of all the substances was to be found in the horny layer after longer periods of absorption. The quantity diffusing into the epidermis and cutis becomes more and more substance-dependent as time of penetration is increased. Graphs of the activity to be found after 300 min in vivo and in vitro penetration times against layer depth were drawn for the four steroids. These results were discussed. (GE)

30397 ABSORPTION OF SODIUM IONS FROM RAT INTESTINE IN VIVO AND FROM A PERFUSED ISOLATED PREPARATION. Gits, J.; Gerber, G. B. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Biophysik; 10: No. 1, 39-43(1973).

Intestinal absorption of different amounts of Na^+ was followed in vivo after injection of a single dose of $^{22}Na^+$ diluted with different amounts of stable Na^+ into the duodenum or the caecal part of the colon and in an isolated piece of small intestine perfused with blood via its natural route. Normal rats display saturation kinetics whereas rats dying from the GI syndrome absorb Na^+ by simple diffusion. The data indicate that the perfused intestine is a system suitable to study absorption under physiological conditions. (GE)

30398 ESTIMATION OF PATHWAYS OF GLUCOSE METABOLISM EMPLOYING [^{14}C] GLUCOSE. Kuemmel, L. (Charles Univ., Prague). Z. Naturforsch., 28C: No. 1/2, 9-13(1973).

A method of quantitative estimation of the contribution of the pentose cycle and the Embden-Meyerhof pathway to erythrocyte carbohydrate metabolism employing [1-^{14}C] glucose and [6-^{14}C] glucose is described. It was found that the ratio of both pathways changes with time of incubation. The contribution of the pentose cycle to glucose metabolism was about 50% and below 10% after 1 hr and 3 to 5 hr incubation, respectively. Methylene blue (1.84×10^{-4} M) increased the contribution of the pentose cycle from 1.5 times to 7 times after 20 min and 3 hrs incuba-

tion, respectively. In view of the inhibitory effect of ATP on glucose-6-phosphate dehydrogenase the dependence of the contribution of the pentose cycle to glucose metabolism on the length of incubation may be related to the possible changes of erythrocyte ATP content during the separation and washing of these cells. (auth)

30399 AUTORADIOGRAPHIC STUDY ON NAPHTHALENE CATARACT. Yuge, T.; Takeda, H. (Kyoto Prefectural Univ. of Medicine). Nippon Ganka Kiyo; 24: No. 3, 187-189(Mar 1973). (In Japanese).

Autoradiography of ^{22}Na and ^{86}Rb was performed in vitro. Pairs of rabbit lenses were incubated in Krebs–Ringer Bicarbonate solution at 37° either with or without β-naphthoquinone, which was reported to be a causal substance of naphthalene cataract. In control lenses, uptake of ^{22}Na was high in the posterior cortical layer and low in the anterior cortical layer, while that of ^{86}Rb was high in the anterior cortical layer and low in the posterior cortical layer. In the lenses incubated with β-naphthoquinone for two hours, accumulation of ^{22}Na increased remarkably in the anterior cortical layer and also increased, in a lesser degree, in the posterior cortical layer. However the accumulation of ^{86}Rb showed no difference between controls and samples, even with preincubation until 30 min and then incubated with ^{86}Rb for 15 min. The higher uptake of ^{22}Na in the anterior cortical layer suggests the inhibition of Na-pump and the increased uptake of the posterior cortical layer suggests the increased permeability. As it was reported in the previous paper that glutathione decreased in the lens incubated with β-naphthoquinone, these increased permability and inhibition of Na-pump are assumed to be caused secondary to the oxidation of glutathione, either direct or indirect via NADPH or ascorbate. The reason for no difference of ^{86}Rb accumulation between controls and samples was not known yet and the longer incubation might cause some difference of the ^{86}Rb accumulation. (auth)

30400 RAPID AND SIMPLE RADIOIMMUNOLOGICAL PROCEDURE FOR MEASURING LOW CONCENTRATIONS OF TETANUS ANTIBODIES. Habermann, E.; Wiegand, H. (Univ., Giessen, Ger.). Naunyn-Schmiedebergs Arch. Pharmakol.; 276: No. 3-4, 321-326(1973).

A radioimmunological assay procedure allows the measurement of small amounts of tetanus antibodies; it should also be applicable to antibodies against other soluble antigens. It is based on the competition between dissolved and solid phase antibodies for labelled antigen. In the range of experimental error, the same antibody titers are found with the radioimmunological and with the mouse protection test. The detection limit is in the range of 0.001 IU/ml. The reaction conditions allow the determination of antibodies in multiple samples. (auth)

30401 QUANTITATIVE DISTRIBUTION OF BOUND IODINE IN THE RAT THYROID FOLLICLE. II. Distribution of Iodine Between Luminal Colloid and Follicular Cells. Simon, C. (Aix-Marseille Univ., Marseille); Droz, B. J. Physiol. (Paris); 66: No. 1, 65-77(Jun 1973).

Quantitative distribution and location of bound iodine within the thyroid follicle were studied by means of electron microscope radioautography on glands of rats in isotopic equilibrium with ^{125}I. Rats received daily either 5 μg of iodine (group 5) or 50 μg of iodine (group 50). In both groups of rats, and for all the sizes of follicles observed, the distribution of bound iodine was homogeneous in luminal colloid, but heterogeneous in follicular cells. Bound iodine concentrations were determined in luminal colloid and follicular cells, and their ratio calculated for each section of follicle observed. In group 50, the concentration ratio colloid/cells is roughly constant and independent of the bound iodine concentration in the luminal colloid. For group 5, in contrast, the bound iodine tends to be maintained at the same concentration in the cell whatever its concentration in the luminal colloid. The cellular bound iodine pool was 10% of the total follicular pool in group 50 but only 4% in group 5. It is concluded that the distribution of bound iodine between luminal colloid and follicular cells and the size of the cellular iodine pool are dependent on daily iodine intake. (FR)

30402 EVALUATION OF ^{99m}Tc SODIUM POLYPHOSPHATE COMPLEX AS A BONE SEEKING AGENT. Nakamura, M. (Tohoku Univ., Sendai); Sawai, Y.; Abe, M.; Takahashi, H.; Nakazawa, N. Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 2, 134-137(Feb 1973). (In Japanese).

The preparation of ^{99m}Tc–sodium tripolyphosphate (STPP) was based on Subramanian's method with slight modification. The organ distribution of ^{99m}Tc– STPP was studied in rats. It was estimated that 43.5% of administered dose was localized in the skeleton 1 hr after injection. The ratio of the concentration in the skeleton to that in the other organs is high enough to delineate the skeletal system using scintiscanner or gamma camera. The urinary excretion of ^{99m}Tc–STPP was 25.4% of the administered dose 1 hr after injection. Various bone diseases are delineated by rectilinear scanning. A blood pool background was high when scan started before 2 hrs post injection. An injection to scan interval of about 3 to 6 hrs seemed satisfactory in many sites. It was possible to delineate skeletal system 24 hrs after injection. Another polysphosphate with a molecular weight of 1500 to 2000 was labeled with ^{99m}Tc and evaluated in our laboratory. The radioactivity in the kidney and urinary excretion were higher than that in ^{99m}Tc–STPP. The activity in the bone was lower than that of ^{99m}Tc–STPP. (auth)

30403 TRANSFORMATION OF ^{14}C-LABELLED GREEN COMPOST IN SOIL. Three Years' Outdoor Pot Experiment. Oberlaender, H. E.; Roth, K. (Landwirtschaftlich Chemische Bundesversuchsanstalt, Vienna). Landwirt. Forsch.; 25: No. 4, 295-318 (1973). (In German).

Green maize was raised in a growth-chamber in presence of $^{14}CO_2$; the uniform label of the maize (110 μc ^{14}C/gC) was confirmed by proximate analysis of the harvested material. Fresh, mashed and dry, ground plants were mixed in clay pots with 10 kg of brown or black earth. The pots were embedded in the ground outdoors and kept free of vegetation. Samples were taken in the course of 3 years and non-humic substances (NH), humic acids (HS), and fulvic acids (FS) were obtained by successive extraction with ethanol-water and $Na_4P_2O_7$. Soil samples, extracted fractions, and the residue (ER) were analyzed for C and ^{14}C. Difficulties in separating humic from non-humic substances are mentioned. The rapid initial decomposition of the green compost slowed down to a constant rate. Two thirds of the added compost C remained in the soil after one month, one fourth after 3 years. Compost made of air-dried plants was initially decomposed more slowly and to a less extent than if made from fresh plants, but the increase in resistance to decomposition was more than offset by carbon losses of 35% observed during air-drying. Whether the experiment was started in August or October had little influence on the retention of compost carbon in the soils in later years. There was no essential difference between the final extent of decomposition of a fivefold and of a single dose of compost applied, nor between types of processes observed in the brown earth and in the black earth. The percent reduction of the NH carbon and of the ER carbon proceeded at the same rate as the decomposition of the whole plant matter applied as green compost; ER obviously consisted of high-polymeric plant constituents. (auth)

MATERIALS

30404 (CONF-710947-P1) PROCEEDINGS OF THE CONFERENCE ON MOESSBAUER SPECTROMETRY, DRESDEN, 20–25 SEPTEMBER 1971. Volume 1. Schnorr, H.; Kautz, M. (eds.) (Deutsche Akademie der Wissenschaften Zu Berlin (East Germany)). 1971. 368p. (In Several Languages).

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

Other methods (NMR, EPR, ESCA, IR, diffraction, PAC, etc.) as well as the Moessbauer effect are considered in this conference. Magnetic and structural properties, relaxation, electronic configuration and chemical bonding, chemical reactions, apparatus and methods, etc. are covered. Twenty-eight papers are included in this volume; separate abstracts were prepared for four of the papers. (DLC)

For abstracts of individual papers see: 30405–30407, and 30556.

30405 (CONF-710947-P1, pp 27-76) CHEMICAL REACTIONS ON THE SURFACE OF A SOLID BODY AND TOPOCHEMICAL REACTIONS. Suzdalev, I. P. (Inst. of Chemical Physics, Moscow). 1971.

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

A review is presented of the use of Moessbauer spectroscopy in studies of: adsorption and chemisorption, catalysis, thermal dissociation of solids, γ-radiolysis of solids, mechanism of topochemical reactions, surface carriers, and oxidation of solids. (55 references, 21 figures) (DLC)

30406 (CONF-710947-P1, pp 157-173) THE hfs OF THE REEMITTED GAMMA RADIATION AND NMR–MOESSBAUER DOUBLE RESONANCE EXPERIMENTS. Meisel, W. (Zentralinstitut fuer Physikalische Chemie, Berlin). 1971.

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

In Moessbauer scattering experiments, normally the whole radiation intensity in an energy range in the vicinity of the Moessbauer gamma line or of an appropriate x radiation is measured. This yields information about the resonant absorption process inside the scatterer, but not about the subsequent re-emission of gamma quanta. A spectral decomposition of the re-emitted quanta is possible, however, by a subsequent second Moessbauer experiment. In this way, the hyperfine structure of the re-emitted gamma line is measurable. Such a spectrum shows line splittings according to the allowed nuclear transitions, if the nuclear spin–lattice relaxation times are long enough. At short relaxation times, line broadenings are expected. For instance, the former is the case in bulk Fe_2O_3; the latter was measured in finely divided and partly superparamagnetic Fe_2O_3 particles. If the scatterer is located in a suitable rf field, then, with the same experimental arrangement, an NMR–Moessbauer double resonance is detectable. The conditions for such a double resonance are discussed. Some experimental results demonstrate the possibility of such experiments. (8 figures, 2 tables, 12 references) (auth)

30407 (CONF-710947-P1, pp 203-227) COMPARISON OF THE PERTURBED ANGULAR CORRELATION AND MOESSBAUER EFFECT METHODS. Keszthelyi, L. (Central Research Inst. for Physics, Budapest). 1971.

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

The angular correlation of two successive γ radiations from a radioactive decay or the angular distribution of γ radiation emitted from a nuclear reaction may be perturbed by magnetic fields through the magnetic moment or by electric field gradients through the quadrupole moment of the intermediate state. This is the same interaction that influences Moessbauer spectra. The methods of measuring perturbed angular correlation in cases of static and dynamic perturbations, their sensitivities, and their relative usefulness compared with Moessbauer effect methods are discussed. As examples, results are reviewed on the hyperfine fields at impurity atoms in ferromagnetic lattices, on frozen aqueous solutions, and especially on the ^{40}K nucleus, (an important, but poorly studied Moessbauer-effect element). (15 figures, 38 references) (auth)

30408 (CONF-710947-P2) PROCEEDINGS OF THE CONFERENCE ON MOESSBAUER SPECTROMETRY, DRESDEN, 20–25 SEPTEMBER 1971. Volume 2. Schnorr, H.; Kautz, M. (eds.). (Deutsche Akademie der Wissenschaften Zu Berlin (East Germany)). 1971. 372p. (In Several Languages).

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

Seventy-two papers and abstracts are included in this volume of the conference which treats other methods such as NMR, EPR, ESCA, diffraction, PAC, as well as Moessbauer. Separate abstracts were prepared for eight papers; three were previously abstracted as NSA 26: 22878, 20419, and 30526. (DLC)

For abstracts of individual papers see: 29957, 29958, 30409–30411, 30557, 30558, and 31465.

30409 (CONF-710947-P2, pp 602-605) MOESSBAUER LINE DEFORMATION BY LOCALLY FLUCTUATING INNER FIELDS AND APPROXIMATE UNFOLDING THEREOF. Meisel, W. (Zentralinstitut fuer Physikalische Chemie, Berlin). 1971.

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

The deviation of the measured Moessbauer line shape from the ideal form is discussed. Various mathematical functions are given, and it is shown how the best value for the form parameter may be determined by computer fitting. Results of unfolding are given for dibutyl tin oxide and its adduct with a halogenated aldehyde and sodium nitroprusside. Spectra of two stainless steels were also analyzed by computer fitting; the line broadening is mainly due to a random magnetic interaction. (3 tables) (DLC)

30410 (CONF-710947-P2, pp 606-609) MOESSBAUER TRANSITION PROBABILITIES IN THE CASE OF COUPLED HYPERFINE INTERACTIONS. Barb, D.; Constantinescu, S.; Tarina, D. (Inst. of Atomic Physics, Bucharest). 1971.

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

Expressions of the Moessbauer emission, absorption, and scattering probabilities for polarized γ-multipole mixtures are given in the case of coupled hyperfine interactions. (auth)

30411 (CONF-710947-P2, pp 625-630) MOESSBAUER DATA COMPLEX PROCESSING SYSTEM. Kucera, J.; Zemcik, T. (Inst. of Physical Metallurgy, Brno). 1971.

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

A universal flexible system for computer processing of experimental data in Moessbauer-effect spectrometry was developed. It consists of two subsequent steps: the primary program for off-line connection of measuring devices to the computer and the secondary least square fitting program. The first one ensures decoding the output punch tapes from the Moessbauer spectrometers, experimental-type corrections, printing the table, plotting the corrected spectrum, and punching the input tape for the least square program. FORTRAN parts had to be completed by machine-oriented subroutines transforming the punch tape contents. Between the two steps, corrections of tapes also are possible and the starting parameters estimation adding is needed. The latter program written in FORTRAN fits a chosen function to the given set of points (obtained in the first step) by means of the least square method. The program is very flexible and may thus be applied to a practically arbitrary form of the approximating function. It consists of about 40 subprograms and comprises 5 different methods of solving the least square problem. From among those methods that one published by Marquardt in 1963 was found to be the most convenient for most of approximating functions. (auth)

30412 (ORNL-4870) METALS AND CERAMICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1973. Peterson, S. (comp. and ed.) (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 123p. Dep NTIS $5.45.

Research is reported in the following areas: fundamental programs (crystals, deformation, diffusion, electron microscopy, ceramics, physical metallurgy, physical properties, superconductors, surface phenomena, theoretical research, x-ray diffraction); space power technology (high-temperature alloys for isotopic heat sources, ^{244}Cm compatibility testing, iridium fabrication, physical metallurgy of heat-source containment materials, tungsten metallurgy); reactor development support (gas-cooled reactor, heavy section steel technology, military reactor fuel element procurement, molten-salt reactor, thorium utilization, research reactor materials); controlled thermonuclear research; transuranium program; biomaterials, graphite fabrication; metallography; and

Auger electron spectroscopy. Separate abstracts (27 total) were prepared of the individual chapters. (DLC)

For abstracts of individual papers see: 30413–30417, 30502, 30503, 30514–30517, 30533, 30559–30561, 30645, 30646, 30667–30669, 31266, 31807–31809, 31860, 31861, and 31908.

30413 (ORNL-4870, pp 1-3) CRYSTAL PHYSICS. Clark, G. W. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

A search for metal oxide–metal coupled eutectic systems led to the discovery of seven binaries and six ternaries. For the ternary Cr_2O_3–ZrO_2–W system, the continuous phase is Cr_2O_3, with ZrO_2 and W appearing predominantly as rods. Tungsten fibers as small as 0.2 μm in diameter at a density of about 10^8 fibers/cm^2 were produced. We assembled an apparatus capable of growing crystals by the standard Czochralski technique and by a new method called edge-defined film-fed growth. Single-crystal boules of ackermanite were pulled (Czochralski) up to 0.8 cm in diameter by 3 cm long. Crystals of BaF_2 undoped and doped with 1 at.% La were grown by the Bridgman–Stockbarger method. Single crystals of $SrCl_2$ 4 mm on a side were grown doped with ^{251}Es in a Bridgman system. Quartz crystals were grown large enough to cut 1-cm^2 wafers for direct measurements of electronic oscillator quality and the temperature dependence of the oscillator frequency. (auth)

30414 (ORNL-4870, pp 7-9) DIFFUSION IN SOLIDS. Lundy, T. S.; Carlson, P. T. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Unpublished initial results are indicated on the effect of dislocations on uranium self-diffusion in UO_2 and binary diffusion in V–Ti solid solutions. (DLC)

30415 (ORNL-4870, pp 19-22) PHYSICAL PROPERTY RESEARCH. McElroy, D. L. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

The accuracy of several physical property measurements was improved by equipment modifications and detailed heat flow analyses. The computerized data acquisition system was improved and interfaced with a thermal expansion apparatus and a thermal diffusivity apparatus. Data on aluminum shows the electronic thermal conductivity to have a shallow minimum and the energy of formation of vacancies to be 0.633 eV. Thermal conductivity measurements on polycrystalline RbI yielded corrections for infrared transmission in single crystals of RbI, RbCl, and RbBr. Thermal conductivity measurements were also made on fibrous carbon insulations. (auth)

30416 (ORNL-4870, pp 28-31) THEORETICAL RESEARCH. Faulkner, J. S. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Theoretical capabilities range from classical elasticity used for lattice defect theory to quantum mechanics used for studies of electrons in ordered or disordered solids. Contributions were made to the development of the Korringa–Kohn–Rostoker and discrete variational method band theory techniques, the coherent potential approximation and its extensions for calculating electronic states in disordered systems, and the anisotropic elasticity theory of dislocations. These techniques are being used to gain an understanding of the properties of technologically interesting materials in their normal states and after radiation damage. (DLC)

30417 (ORNL-4870, pp 32-36) X-RAY DIFFRACTION. Yakel, H. L.; Borie, B. S. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Observation is reported of a kind of inelastic scattering, or resonance emission of x rays, not previously observed. Diffraction research described includes studies of short-range structures in the omega phase (Ti and Zr-base solid solutions) and in certain uranium alloys (both of which result from rapid cooling of a bcc structure) and the crystal structure and expansion coefficients of certain boron carbides. (DLC)

30418 PRODUCTION AND APPLICATION OF RARE EARTH FERRIMAGNETIC GARNETS. Part 2. Applications in Bubble Domain Stores. Brown, C. S. (General Electric Co. Ltd., Wembley, Eng.). pp 315-330 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

The application of magnetization reversal for representation of the two binary states has been used for many years in digital stores. The discovery of the magnetic bubble domain provides the first opportunity of producing a high-density backing store without moving parts. Following a discussion of the physics of bubble domains and the conditions under which they exist, the materials which can be used are considered. It is shown why the rare earth garnets are suited to this application and techniques for the epitaxial deposition of the thin films required are described. Finally a short review is given of the manner in which bubble domains can be used as a serial shift register store as a potential replacement for the mechanical systems. (auth)

30419 PRODUCTION AND APPLICATION OF RARE EARTH FERRIMAGNETIC GARNETS. Part 1. Applications in Microwave Components. Brown, C. S. (General Electric Co. Ltd., Wembley, Eng.). pp 297-313 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO advanced study institute; Kjeller, Norway (23 Aug 1972).

Application of rare earth ferrimagnetic garnets in microwave devices is dealt with. The basic physics of the interaction of microwaves and magnetic insulators is outlined and related to the application of ferrites in microwave isolators, circulators, and phase shifters. To obtain the required performance, many material parameters must be controlled, and it is shown that the garnet structure is ideally suited in that a wide range of ions may be substituted into the basic yttrium iron garnet structure to modify the properties in the desired manner. Ceramic production technology is outlined and an indication of the application of ferrite devices in microwave systems is given. (auth)

30420 PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON CHEMICAL VAPOR DEPOSITION. Conference Held at Salt Lake City, Utah, April 24–27, 1972. Glaski, F. A. (ed.) Hinsdale, IL; American Nuclear Society (1972). 800p. (CONF-720410-).

Sixty-four papers and abstracts are included. Topics treated cover fundamentals and techniques of CVD processes, TiC coatings, CVD of thin films, CVD composites, protective and wear-resistant coatings, CVD applications, and evaluation and properties of CVD materials. Separate abstracts were prepared for 23 of the papers; 7 of the remaining have been previously abstracted as NSA 26: 28599, 28600, 31491, 33550, 36488, 41387; and 27: 15257. (DLC)

For abstracts of individual papers see: 30463–30470, 30509–30511, 30539–30548, 30590, and 30591.

Ceramics and Cermets

Refer also to abstracts 29782, 29783, 30512, 30513, 30519, 30520, 30522, 30523, 31806, 31818, 32138, 32142, 32167, 32170, 32208, and 32211.

30421 (AD-751497) SUPERCONDUCTIVITY AND MAGNETISM OF INTERCALATED AND INTERMETALLIC COMPOUNDS. Final Report, 1 January 1968–30 September 1972. Geballe, T. H. (Stanford Univ., Calif. (USA). Dept. of Applied Physics). 30 Sep 1972. Contract AF-AFOSR-1510-68. 12p. (AFOSR-TR-72-1972). NTIS.

Research on the synthesis of new superconducting compounds is described briefly. The interactions giving rise to their superconductivity were studied by magnetic, electrical and thermal techniques. The magnetic ordering in a series of rare-earth compounds was also studied, particularly the interaction of localized 4f levels with the conduction electrons. New calorimetric and optical reflectivity measuring apparatus were developed which make use of silicon chip devices operating at low temperatures. (auth)

30422 (ANL-Trans-946) OBTAINING OF HIGH THERMAL GRADIENTS IN UO_2 HEATED BY THE JOULE EFFECT: OBSERVATIONS IN COLUMNAR RECRYSTALLIZATION. Kurke, G. Translated from J. Nucl. Mater.; 37: 133-138(1970). 10p. Dep. NTIS $3.00.

By passing an electric current through cylindrical UO_2 specimens it is possible to obtain thermal gradients up to 5000°C per cm. The temperature distribution in the interior of the sample has been calculated and the validity of this calculation has been checked by means of optical pyrometry measurements. Under certain conditions of temperature and temperature gradient, columnar grains are formed; their diameter is of the same order as that deduced from models based on evaporation–condensation mechanisms. (auth)

30423 (JUL-945-FF) ELECTRON MICROSCOPY OF β-HYDRIDE IN NIOBIUM. Schober, T.; Pick, M. A.; Wenzl, H. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). (Inst. fuer Festkoerperforschung). Apr 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Electron microscopy of the β-hydride phase of Nb showed domain boundaries with δ-fringes arising from the ordering of hydrogen. A diffraction analysis carried out on a single domain resulted in a reciprocal lattice which is identical with the one deduced from neutron diffraction experiments. The β-hydride structure in Nb belongs to the orthorhombic space group P_{nnn} with Nb atoms on f(000, 0 ½ ½, ½ 0 ½, ½ ½ 0) and H on a (¼ ¼ ¼, ¾ ¾ ¾ and b (¾ ¼ ¼, ¼ ¾ ¾). (auth)

30424 (JUL-946-RW) STUDY ON THE FLUIDIZED-BED COATING OF NUCLEAR FUEL KERNELS. Haange, R.; Gyarmati, E.; Nickel, H. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). May 1973. 109p. (In German). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis. Submitted to Technische Hochschule Aachen (West Germany).

In a fluidized bed of a conical 3-inch coating furnace, temperature gradients, zones of deposition, and the composition of the gas mixture in and above the bed were studied. Measurements using thermocouples as well as theoretical considerations led to establishment of the temperature distribution among the particles and the gas composition across the bed. Thermal equilibrium was found to exist between the incoming gas and the bed of particles beyond a short heating stage above the nozzle system. No significant axial temperature gradients were detected; radial temperature gradients remain small (<20°C). Zones of deposition were defined by thickness measurements carried out on the pyrocarbon deposits obtained on small fixed rods mounted in the bed. Comparison of plasma-oxidized pyrocarbon deposits on particles and fixed rods demonstrates the strong influence of particle movement and gas velocity on the structure of the pyrocarbon. Gas was sampled in the zone of reaction by a suction method using small graphite tubes. The samples were analyzed by gas chromatography and mass spectrometry. Measurement results compared with calculated gas composition for the thermodynamic equilibrium case rendered the composition to approach that of equilibrium above the heating stage. (45 figures, 67 references)

30425 (JUL-950-RW) CHEMICAL FUNDAMENTALS OF HYDROLYSIS PROCESS FOR THE PRODUCTION OF SPHERICAL NUCLEAR FUEL PARTICLES. Foerthmann, R. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). May 1973. 39p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

Preparation of UO_2 microspheres by a hydrolysis process is based on the solidification of droplets of a concentrated uranyl nitrate solution in hot oil. The uranyl nitrate is complexed by urea and partly hydrolyzed by adding solid hexamethylenetetramine. The temperature depending solidification reaction of the metastable solution is a continuous polymerization of $[(UO_2(OH)_2)_n UO_2]^{2+}$ ions forming colloidal $UO_2(OH)_2$. The crystallite size of the spherical gel particles is increased by washing with hot water. Heat treatment of the washed and dried particles in reducing atmosphere leads to UO_2 with excellent sintering behavior. The process was also used in the preparation of ThO_2 and $(U,Th)O_2$ microspheres. (auth)

30426 (KFK-1523) DESIGN, IRRADIATION, AND POST IRRADIATION EXAMINATION OF THE UO_2/PuO_2 FUEL PIN IRRADIATION EXPERIMENTS OF THE FR 2 CAPSULE GROUP NO. 4a. Freund, D.; Dippel, T.; Geithoff, D.; Weimar, P. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). 21 Mar 1973. 244p. (In German). Dep. NTIS (U.S. Sales Only) $14.25.

The irradiation of 28 UO_2-PuO_2 fuel pin samples in the thermal flux of the Karlsruhe research reactor FR 2 represents a first testing of the SNR basic fuel pin concept. The irradiation has been carried out in 9 Na/PbBi double-capsules, where 3 to 4 samples are stacked one above the other. The fuel column of 80 mm length consists of pellets with a Pu-content of 15 wt%. Fuel densities of 85 and 92% T.D., corresponding to smeared densities of 81 or 84% T.D., have been realized. The austenitic stainless steel claddings have an outer diameter of 7.4 mm with a wall thickness of 0.5 mm. The total length of the fuel pin is 172 mm. The capsules have been irradiated at normal fuel element or isotope canal positions. At linear rod powers up to 700 W/cm and clad surface maximum temperatures of 600°C, the burnup lies between 10 and 90 MWd/kg metal. The samples have been irradiated between 57 and 578 days full power (44 MW) equivalent. All fuel pins are intact in spite of single central fuel melting. A compilation of design, specification, and fabrication as well as a detailed description of irradiation and post irradiation examination results are given. (GE)

30427 (KFK-1836) CONCERNING THE SINTERING OF UO_2-PuO_2 PELLETIZED FUEL FOR IRRADIATION EXPERIMENTS. Dippel, T.; Pollanz, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkörperforschung). Jul 1973. 63p. (In German). Dep. NTIS (U.S. Sales Only) $5.25.

The fabrication method for uranium–plutonium mixed oxide fuel pellets produced in the Plutonium Laboratory of the Institut für Material und Festkörperforschung is described. Detailed fabrication data are presented under the titles of the irradiation test groups. The influence of various parameters on the fabrication process and the sintered product is discussed. A method for predetermination of changes in geometry and density is given for pellets made from a well-known powder feed material. (auth)

30428 (KFK-1844) POLYMORPHISM OF AMERICIUM SESQUIOXIDE AND CONTRIBUTIONS TO THE STABILITY OF THE MODIFICATIONS OF THE RARE EARTH OXIDES. Maier, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Jul 1973. 110p. (In German). Dep. NTIS (U.S. Sales Only) $7.50.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

Experimental results concerning the influence on modifications of the trivalent f-element oxides by the incorporation of other oxides led to investigation of the polymorphism of $AmO_{1.5}$ at 900 to 1500°C. There was no indication of the existence of B-$AmO_{1.5}$. By incorporation of $SmO_{1.5}$ the phase B-$AmO_{1.5}$ was obtained, however. In order to get quantitative data on the crystal chemical stability of polymorphous rare-earth-oxide modifications, a systematic experimental examination was performed on the phase relationships in the systems $LaO_{1.5}-SEO_{1.5}$ (SE = Ce–Lu) and $YO_{1.5}-SE'O_{1.5}$ (SE' = La–Lu) between 1250 and 1550°C. For the width of the existing phases, continuous developing relations were found. These results may be used for the estimation of the boundary compositions of similar, yet unknown quasi-binary oxide phases. The compounds $LaHoO_3$, $PrLuO_3$ and $NdLuO_3$, crystallizing in the orthorhombic perovskite-structure, are reported for the first time. (auth)

30429 (ORNL-TM-4226) EUROPIUM OXIDE AS A POTENTIAL LMFBR CONTROL MATERIAL. Pasto, A. E. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 80p. Dep. NTIS $5.45.

Europium oxide has been suggested as a possible neutron absorber material for use in the control rods of LMFBRs. A review of the literature data for Eu_2O_3 is presented concerning its physical properties and characteristics, and is an evaluation of the current status of the data regarding reactivity worth, compatibility, irradiation stability, and in-reactor heating rate. Preliminary fabrication experiments are also described. It is concluded that the monoclinic form of Eu_2O_3 is an excellent candidate absorber material. It is readily fabricated into dense pellets by sintering or hot pressing, has an initial nuclear worth equivalent to that of natural B_4C, and retains a significant portion of this worth during burnup due to its "chain-type" neutron absorption behavior. However, few data are available regarding the fast neutron irradiation behavior of Eu_2O_3 pellets and their compatibility with structural materials and coolants. A cursory evaluation of other oxides of europium is also included. (auth)

30430 (SGAE-2143) CHEMICAL AND ELECTROCHEMICAL METHODS FOR DECONSOLIDATION OF GRAPHITIC REACTOR FUEL BODIES. Bildstein, H.; Knotik, K.; Stolba, G. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H., Seibersdorf. Institut fuer Chemie). Jun 1973. 24p. (In German). Dep. NTIS (U.S. Sales Only) $3.25.

A review is presented of the disintegration problems of graphitic fuel bodies. It shows the possibilities of disintegrating graphite compacts using the formation of graphite intercalation compounds. Chemical and electrochemical methods used for testing fuel bodies are discussed. Electrolytic cells for specific investigations on various fuel compacts and compact fragments are described along with their functions. (auth)

30431 (SLL-73-26) CONSOLIDATION AND CHARACTERIZATION OF POROUS URANIUM HYDRIDE STRUCTURES. Lindsay, P. B. (Sandia Labs., Livermore, Calif.). Sep 1973. Contract AT(29-1)-789. 28p. Dep. NTIS $3.50.

Porous uranium hydride parts have been fabricated successfully from two high-specific-surface-area powders. These parts retain a moderately high surface area and good open porosity characteristics while maintaining sufficient strength for machining operations. (auth)

30432 (UJV-2933-M) STATIC DISPLACEMENT OF CRYSTAL LATTICES OF NbC AS CRITERION OF SINTERABILITY. Krivy, I.; Becvar, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1973. 24p. (In Czech). Dep. NTIS (U.S. Sales Only) $3.25.

The effects of thermal treatment of NbC on size of static displacements in the crystal lattice (size of U^2_{stat}) and on sinterability were investigated. The x-ray Bragg-intensity measurements at room temperature showed that substantial part of the static displacements may be removed by two hours thermal heating in vacuum at a temperature ≥ 1100°C. The dependence of sintered NbC pellet density on preliminary heating temperature is found to be qualitatively equal to temperature dependence of U^2_{stat} quantity. The larger the value of U^2_{stat}, the higher the pellet density under fixed conditions. The criterion seems to hold also for other powders of both metallic and ceramic nature. (auth)

30433 (Y-1852(Pt. 1)) NERVA FUEL ELEMENT DEVELOPMENT PROGRAM. Summary Report, July 1966–June 1972. Extrusion Studies. Napier, J. M. (ed.) (Oak Ridge Y-12 Plant, Tenn. (USA)). 21 Sep 1973. Contract W-7405-eng-26. 119p. Dep. NTIS $5.45.

Collected data on NERVA extruded graphite fuel elements are presented. The physical properties of the fuel element reached the following values: coefficient of thermal expansion (CTE) – 7.0×10^{-6}/°C at 25 to 1000°C; modulus of elasticity – 1.5×10^6 psi; flexural strength – ~8000 psi; ultimate strain to failure – 5500 μin/in; and good thermal stress resistance. Matrices were produced which could be vapor coated with crack-free films of zirconium carbide. The CTE of the matrix was almost equal to the CTE of the zirconium carbide coating. (auth)

30434 (Y-1852(Pt. 2)) NERVA FUEL ELEMENT DEVELOPMENT PROGRAM SUMMARY REPORT, JULY 1966–JUNE 1972. Impregnation Studies. Napier, J. M. (comp.) (Oak Ridge Y-12 Plant, Tenn. (USA)). 21 Sep 1973. 60p. Dep. NTIS $5.45.

Various types of graphites were manufactured during the NERVA fuel element development program to obtain data on the effects of fillers and binders, and to characterize the physical properties of a variety of graphites. These graphites ranged structurally from near isotropic to anisotropic. Open porosities of the before-impregnated bodies were generally 16 to 20 percent with bulk densities being dependent on the filler, binder, and other process conditions. A density range of 1.60 to 1.80 g/cm^3 was typical for most of the unimpregnated graphites. Two methods were employed to densify graphite bodies: gaseous impregnation and liquid impregnation. Gaseous impregnation consisted of two processes: direct flow and pulse vacuum. Liquid impregnation was based on the use of a polymer of cinnamylideneindene. Both types of gaseous impregnation processes were successful in densifying the fuel element graphites; however, the process time of the pulse-vacuum method was shown to be significantly shorter than that of the direct-flow process. The liquid impregnation process was also successful. Two to four impregnation cycles were required to obtain a maximum density. (auth)

30435 (Y-1852(Pt. 3)) NERVA FUEL ELEMENT DEVELOPMENT PROGRAM SUMMARY REPORT, JULY 1966–JUNE 1972. Characterization of Vapor-Deposited Niobium and Zirconium Carbides. Caputo, A. J. (comp.) (Oak Ridge Y-12 Plant, Tenn. (USA)). 21 Sep 1973. Contract W-7405-eng-26. 42p. Dep. NTIS $4.00.

Chemical and physical properties of vapor-deposited niobium carbide and zirconium carbide have been determined by the fabrication of thick-wall tubes of each carbide under varying deposition conditions. The effects studied included coefficient of thermal expansion, density, impurity level, carbon-to-metal ratio, and metallographic structure. The niobium carbide coatings contained less than 3000 ppM impurities, and the impurity level decreased when the deposition temperature was increased. Some of the zirconium carbide coatings contained four percent oxygen and chlorine, and the impure coatings were unstable when heated above the deposition temperature of 1100°C. The amount of instability was primarily related to the oxygen and chlorine content; an increased deposition temperature reduced the impurity contents to less than 500 ppM. The higher-temperature process conditions produced coatings with a predictable and consistent coefficient of thermal expansion value which could be repeatedly heated to 2000°C (~700°C above the deposition temperature) without any detrimental effects such as weight and volume changes. The weight and volume changes were related to the impurities being evolved when the coatings were heated to temperatures of 1600 to 1800°C. (auth)

30436 (Y-1852(Pt. 4)) NERVA FUEL ELEMENT DEVELOPMENT PROGRAM SUMMARY REPORT, JULY 1966–JUNE 1972. Vapor Deposition of Metal Carbides. Caputo, A. J. (comp.) (Oak Ridge Y-12 Plant, Tenn. (USA)). 21 Sep 1973. Contract W-7405-eng-26. 58p. Dep. NTIS $5.45.

Vapor deposition processes used at Y-12 for coating NERVA graphite fuel elements have been completed. This effort included the deposition of: (1) niobium carbide at 1700 to 2000°C, (2) niobium carbide at 1000 to 1300°C, (3) zirconium carbide at 1000 to 1400°C, and (4) niobium carbide plus zirconium carbide at 1000 to 1250°C. Various properties (e.g., coefficient of thermal expansion, density, crystal structure, and impurities) of each were determined in order to characterize each coating or combination of coatings. (auth)

30437 (Y-1852(Pt. 5)) NERVA FUEL ELEMENT DEVELOPMENT PROGRAM SUMMARY REPORT, JULY 1966–JUNE 1972. Ion Exchange Resin Fuel Beads. Clark, F. E. (comp.) (Oak Ridge Y-12 Plant, Tenn. (USA)). 21 Sep 1973. Contract W-7405-eng-26. 51p. Dep. NTIS $5.45.

For some years, the standard fuel for NERVA reactors had been commercially available, spherical particles of uranium dicarbide encapsulated in a shell of pyrocarbon. The fuel particles were incorporated into a fuel element formed by extruding a blend of graphite powder, fuel particles, and binder. The extruded shape was then heat treated up to 2200°C to carbonize the binder. The NERVA rocket had a maximum temperature capability, which was partially due to the thermal stability of the fuel particles. It was desirable to obtain fuel particles that could be heated to temperatures in excess of 2400°C without loss of the uranium to the fuel-element matrix. Fuel particles, made by adding uranium to commercially available ion-exchange resins, have been demonstrated to be stable at temperatures greater than 2400°C. Utilization of these types of particles for NERVA applications was not completed by the time the program was terminated. However, this brief study had shown that these particles may be a useful, high-temperature nuclear fuel. (auth)

30438 FORMATION OF U_2C_3 FROM UC_2. Kikuchi, A.; Ogawa, K.; Iwamoto, K. (Japan Atomic Energy Research Inst., Takai-mura). J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 446-448(Jul 1973).

A study was conducted of the effects of stress on the stability of UC_2 particles during out-of-pile heating. It was found that UC_2 decomposes into U_2C_3 by heating at temperatures from 1,370 to 1,450°C under a stress of about 750 kg/cm^2, and that the maximum yield of U_2C_3 occurred at around 1,400°C. These results suggest that the dicarbide used as the kernel of the coated fuel particles may decompose during use in a HTGR when both the temperature and the pressure around the kernel acquire the values described. (JRD)

30439 LUMINESCENCE OF UNDOPED MgO UNDER IRRADIATION WITH 500-keV PROTONS. Seiyama, T.; Yoshida, T.; Hiraoka, E. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 73-75(1972).

The 361-nm zero-phonon line which was always accompanied by the 376-nm luminescence band was produced in undoped MgO by 500-keV proton irradiation. The luminescence bands of N^{2+} ions and Cr^{3+} ions existing in octahedral and tetragonal symmetries was observed under the proton irradiation. All the luminescence bands were observed to decrease in intensity with irradiation. Two stages were found of annihilation processes of the two types of the luminescence centers; Cr^{3+} ion-anion vacancy associate ($Cr^{3+}-O^{=}-V_{Mg}$), and Cr^{3+} ion–anion vacancy pair ($Cr^{3+}-O^{=}-V_{Mg}-O^{=}-Cr^{3+}$), which are governed by first-order reaction kinetics. (auth)

30440 SOLDERING AND BRAZING OF ADVANCED METAL-MATRIX STRUCTURES. Robertson, A. R.; Miller, M. F.; Maikish, C. R. (General Dynamics/Convair, San Diego, CA). Weld. J. (N. Y.); 52: No. 10, 446-s-453-s(Oct 1973).

From 2nd international soldering conference; Chicago, Illinois (3 Apr 1973).

There is increased awareness of the potential weight savings resulting from the use of advanced composites in aerospace designs. Boron/aluminum, one of these advanced composites, has been shown to be adaptable to a full range of joining techniques. Soldering of boron/aluminum is applicable over a wide range of temperatures, and has no deleterious effect on the boron filaments. Room temperature lap shear strengths for various solders range from 10 ksi to more than 12 ksi; certain solders have lap shear strengths as high as 4.5 ksi at 600°F. Boron/aluminum is brazed using aluminum-silicon alloys, at temperatures up to 1,140°F, either by dip brazing in a molten bath or fluxless brazing in a vacuum. Even short exposures at these elevated temperatures can cause serious degradation of the boron filaments. In an effort to reduce brazing temperatures, a development program has been conducted using eutectic diffusion brazing. This fluxless process uses an elemental metal interface. Upon heating, a low melting

point eutectic alloy forms and diffuses from the interface, leaving a joint with a remelt temperature 200 to 500°F higher than the brazing temperature. (auth)

30441 REACTIONS BETWEEN SiC AND SrO AT HIGH TEMPERATURE. Suzuki, H. (Tokyo Inst. of Tech.); Iseki, T.; Nakamura, T. J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 360-366(Jun 1973).

A mixture of SiC and SrO was heated in air, in Ar and in vacuum, and the reaction products were determined by powder x-ray diffraction. The reaction began above 1000°C and the products varied, depending on the oxygen content in the heating atmosphere. For example, in the case of a mixture of 1:1 in atomic ratio, SrO · SiO_2 formed in air, while in oxygen-free atmosphere, SrC_2 and Sr were produced besides 2SrO · SiO_2. It was also found that the powder x-ray diffraction pattern of 2SrO · SiO_2 obtained in the experiment differed in part from O'Daniel's data. It is concluded that study of the microstructural changes in the SiC coating layer at high temperatures should be most important for assuring retention of the fission products Sr and Ba in coated particle fuels. (auth)

30442 USE OF CAST CLADDING FOR FABRICATION OF PLATE FUEL ELEMENTS. de Freitas, C. T.; de Souza Santos, T. D.; Gentile, E. F.; Ambrozio Filho, F. (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo); 28: No. 171, 121-128(Feb 1972). (In Portuguese).

Results obtained in the cast cladding fabrication of fuel plates are presented; the plates have an Al–U_3O_8 dispersion core. Dispersions containing from 20 to 50 wt % of the ceramic phase were used. Ceramic powders characterization developed by pycnometer density determinations, surface area measurements using a modified BET method, and x-ray spectrometry is described. Process variables such as compacting pressure, casting temperatures of the aluminum cladding, and rolling reductions were studied; in this way it was possible to identify the origin of defects found in the finished fuel elements. Emphasis was given to tests for the determination of the fuel core components and their degree of bonding with the aluminum cladding. Fuel plates satisfying the current international specifications were obtained. (auth)

30443 PHASE EQUILIBRIA IN THE V_2O_3–VO_2 SYSTEM AT HIGH TEMPERATURES. Endo, H. (Tokyo Inst. of Tech.); Wakihara, M.; Taniguchi, M.; Katsura, T. Bull. Chem. Soc. Jap.; 46: No. 7, 2087-2090(Jul 1973).

The phase equilibria in the V_2O_3–VO_2 system were established at 1307°K by varying the oxygen partial pressures from 10^{-4} to 10^{-12} atm. Eight phases, V_2O_3, V_3O_5, V_4O_7, V_5O_9, V_6O_{11}, V_7O_{13}, V_8O_{15}, and VO_2, were observed under these experimental conditions. Vanadium sesquioxide has an extensive range of solid solutions at 1307°K. Also, the phase diagram and isobaric lines of oxygen partial pressure in the V_2O_3 phase were determined from 1307 to 1700°K. Quenching and thermogravimetric methods were applied under a controlled oxygen atmosphere. The oxygen partial pressures were determined by means of a solid electrolyte cell composed of $(ZrO_2)_{0.85}(CaO)_{0.15}$. The standard free energies of the oxidation of V_2O_3 to V_3O_5, of V_3O_5 to V_4O_7, of V_4O_7 to V_5O_9, of V_5O_9 to V_6O_{11}, of V_6O_{11} to V_7O_{13}, of V_7O_{13} to V_8O_{15}, and of V_8O_{15} to VO_2 were determined on the basis of the equilibrium oxygen partial pressure at 1307°K. The enthalpy and entropy data of the oxidations of V_2O_3 to V_3O_5 and of V_3O_5 to V_4O_7 were evaluated from the oxygen partial pressures. (auth)

30444 ELECTRON MICROSCOPE STUDY OF SOME CERAMIC MATERIALS FOR NUCLEAR APPLICATIONS. Faulkner, D. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). J. Can. Ceram. Soc.; 19-25(1972).

The use of scanning and transmission electron microscopy techniques for the characterization of ceramic materials is discussed with reference to observations made on silicon carbide, magnesium oxide, and aluminum oxide. In particular, the effect of neutron irradiation on the structure of silicon carbide and magnesium oxide is described, and the use of high-voltage (1 MV) electron microscopes for radiation damage studies is outlined. The technique of ion-bombardment thinning (or ion milling) for preparing suitable specimens for transmission electron microscopy is described and applications are given. (auth)

30445 HEAT OF WETTING OF VARIOUS BeO POWDERS IN WATER AND THEIR SINTERABILITY. Ikegami, T. (National Inst. for Researches in Inorganic Materials, Sakura, Japan); Matsuda, S.; Suzuki, H. Yogyo Kyokai Shi; 81: No. 936, 322-326 (Aug 1973). (In Japanese).

Studies have been made on the heat of wetting (ΔH_i) at 25°C in water for various BeO powders which were prepared at various temperatures from 200 to 1000°C and the shrinkage of compacts under heating rate of 10°C/min. It was found that the values of ΔH_i increase from about 400 to 1500 erg/cm² with outgassing temperature from 200 to 800°C. ΔH_i reaches maximum at about 800°C for those except CF-BeO(NGK Insulators, Ltd.), ΔH_i of which increases monotonously to 1000°C. Although ΔH_i of BeO powders obtained from hydroxide show the highest values and ΔH_i from sulfate are higher than CF-BeO between 200 and 1000°C, sinterability increases with decreasing ΔH_i. The amounts of gas desorbed from the BeO powders are decreased with increasing the outgassing temperature except CF-BeO, those of which are less between 600 and 800°C than between 800 and 1000°C. (auth)

30446 RELEASE OF FISSION PRODUCTS FROM UO_2 MELTED IN AIR AND IN HELIUM. Kawahara, S.; Murata, T.; Yusa, H. (Hitachi Ltd., Ibaraki, Japan). Nippon Genshiryoku Gakkaishi; 15: No. 6, 428-433(Jun 1973). (In Japanese).

Studies of fission-product (F.P.) release from UO_2 were made under out-of-pile conditions. A lightly irradiated UO_2 pellet was placed in a Zircaloy-2 crucible and heated by induction to the melting temperature of UO_2 in air and in He. The activities of the released F.P. deposited on the vessel wall, trapped by a millipore filter and by a cooled charcoal trap, were separately measured by scintillation counter. Most of the F.P. were released in particulate form except for ^{133}Xe and ^{131}I, which were trapped by the charcoal trap. Among the main F.P., ^{95}Nb and ^{147}Nd were not detected outside the crucible, probably being all adsorbed on the crucible. A simple relation was found between the boiling temperature of the F.P. elements and the rate of the F.P. release. (auth)

30447 EFFECT OF NONHYDROSTATIC STRESSES ON PHASE TRANSFORMATIONS OF U_3O_8 AT ROOM TEMPERATURE. Tsvigunov, A. N.; Kovba, L. M.; Zubova, E. V.; Savranskii, V. V.; Oparnikov, G. L. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 210: No. 2, 365-366(11 May 1973). (In Russian).

Results of studies are presented on the phase transformations of alpha-U_3O_8 at room temperature under complex nonhydrostatic stresses (simultaneous compression and shear) as created in the process of grinding the alpha-U_3O_8 in a ball mill. The starting compound was obtained by calcining the uranium peroxide hydrate at 650°C to a constant weight. After two hours of grinding the x-ray diagram showed the presence of beta-U_3O_8, but complete transformation of the alpha form to the beta was not observed. A trace of a cubic phase was also detected. The amount of cubic phase increased with increasing grinding time. After a week the α-U_3O_8 had almost completely transformed to a cubic phase having the composition $UO_{2.67}$. In addition the formation of the impurity α-U_2O_5 + x was also observed. The grinding of the uranium oxide is accompanied by the adsorption of a noticeable amount of water. On heating the cubic phase $UO_{2.67}$ three effects were noted: an endothermic effect at 100 to 150°C which is explained by the evolution of water, an exothermic effect at 330°C which corresponds to the oxidation of $UO_{2.67}$ (cubic) to a hexagonal phase α-$UO_{2.85}$, and a third endothermic effect at 660°C which corresponds to the decomposition of α-$UO_{2.85}$ (hexagonal) to U_3O_8. Repeated grinding of α-U_3O_8 gave well-crystallized samples of the cubic phase which was found to have a face-centered lattice with a = 5.418 A. Four formula units of $UO_{2.67}$ enter into the elementary cell with the x-ray density d = 11.72 g/cm³. (SJR)

30448 PECULIARITIES OF STRUCTURE AND SOME PROPERTIES OF MATERIALS OBTAINED BY HOT PRESSING. Mai, V. K.; Denisenko, E. T. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 6, 29-32(Jun 1973). (In Russian).

Results of investigations of changes occurring in fine crystalline structure of NiCr–ZrO_2 in the process of hot pressing are presented. The recovery and recrystallization of hot-pressed samples deformed at room temperature and hot microhardness are investigated. On the basis of the data obtained, it is concluded that the role of nonlinear creep in the compaction mechanism during hot pressing is dominant. It is established that the change in substructure is determined by conditions both of mixture obtaining and hot pressing and depends also on preliminary thermal treatment of the powder. (auth)

30449 APPLICATION OF REFRACTORY CARBIDES IN RESISTORS. Grebenkina, V. G.; Sorokin, V. N.; Yusov, Yu. P.; Perevezentsev, A. V. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 6, 83-86(Jun 1973). (In Russian).

A comparison of HWV (heat-, wet-resistant, volumetric) and RAV (resistance, variable, volumetric) resistors is given, based on their main parameters. Simple and complex carbides of the 4–6 groups of the periodic system are tested for the current-conducting phase in the RAV resistors. Comparison of the produced industrial types of resistors with their experimental samples, on the basis of zirconium–tungsten carbide complexes, showed the advantages of the latter in the whole series of parameters. (auth)

30450 CHEMICAL TRANSPORT OF MOLYBDENUM AND TUNGSTEN AND OF THEIR DIOXIDES AND SULFIDES. Schaefer, H.; Grofe, T.; Trenkel, M. (Univ., Muenster, Ger.). J. Solid State Chem.; 8: No. 1, 14-28(Sep 1973).

Experiments were conducted on the chemical transport of Mo, W, MoO_2, WO_2, MoS_2, and WS_2 in the presence of iodine, and extensive thermodynamic discussion is included. Efforts were made to find the species via which Mo and W can migrate within the gas phase. In each case the transport proceeds via the oxide iodides MoO_2I_2 and WO_2I_2, respectively, as already known for the dioxides. Thus the chemical transport of Mo, W, MoS_2, and WS_2 needs not only I_2 but also H_2O, usually liberated from the wall of the quartz ampul. By means of $I_2 + H_2O$, the metals can be transported into the high-temperature region of the ampul (e.g., 1050 → 1150°C), whereas the transport of the sulfides proceeds in the opposite direction (e.g., 900 → 700°C). For the sulfide transport the influence of the ratio of the transport agents I_2/H_2O is discussed. The water content of the quartz from which the ampuls are made is a source of water in the reactions. The addition of graphite which lowers the H_2O partial pressure prevents transport of the metals or the sulfides; this proves that the use of I_2 alone as a transport agent is insufficient in these cases. The gaseous iodides MoI_x and WI_x are not important under the experimental conditions used for the transport of the metals, their dioxides and sulfides. The partial pressures of $MoO_2(OH)_2$ and $WO_2(OH)_2$ under the experimental conditions chosen may usually be neglected, but in the system MoO_2/H_2O the transport via $MoO_2(OH)_2$(1000 → 800°C) has been observed. The synthesis of MoO_2 and WO_2, starting with the elements or with powder of metal and trioxide is promoted by the addition of I_2. The reaction steps involved are discussed. (auth)

30451 DIBORIDES AND TETRABORIDES OF MAGNESIUM: CRYSTALLOCHEMICAL CONSIDERATIONS OF THE TETRABORIDES. Naslain, R.; Guette, A.; Barret, M. (Univ., Bordeaux). J. Solid State Chem.; 8: No. 1, 68-85(Sep 1973). (In French).

MgB_2 and MgB_4 were prepared at high temperature in sealed molybdenum vessels from mixtures of the elements. The utilization of an excess of metal in the vessel generates a pressure of magnesium vapor which inhibits thermal decomposition of the compounds during the synthesis. The structure of MgB_4 has been established from single crystal data collected on an automatic diffractometer. MgB_4 is orthorhombic, space group Pnam with a = 5.464; b = 7.472; c = 4.428 Å and Z = 4. The structure of MgB_4, is based on chains of boron pentagonal pyramids in which the averaged B-B bond is 1.787 Å. Interchain B-B bonds of 1.730 Å are responsible for the three-dimensional boron framework. The Mg atoms, located in tunnels, form zigzag chains. The structure of MgB_4 is compared with those of ThB_4 and CrB_4; it is concluded that the size of the metal atom plays an important role in the nature of the boron framework which exists. In MgB_4, the fundamental unit of the boron skeleton is a pentagonal pyramid; a new feature, in boron-rich borides where this type of coordination polyhedron was previously found only in B_{12} icosahedra. (12 figures, 24 references) (auth)

30452 ELECTROCHEMICAL REDUCTION OF MOLYBDENUM (VI) COMPOUNDS IN MOLTEN LITHIUM CHLORIDE–POTASSIUM CHLORIDE EUTECTIC. Popov, B. N. (Univ. Kiril and Metodij, Skopje, Yugoslavia); Laitinen, H. A. J. Electrochem. Soc.; 120: No. 10, 1346-1350(Oct 1973).

Molybdenum(VI) oxide reacts with molten LiCl–KCl eutectic at 450°C to form MoO_2Cl_2, which probably is present as an anion $MoO_2Cl_4^=$, and pyromolybdate, $Mo_2O_7^=$. Both of these species are electrochemically reduced to MoO_2, which can be reoxidized to MoO_2Cl_2 by current reversal. A second reduction step, observed whether MoO_3 or $Mo_2O_7^=$ is added to the melt, can be attributed to the reduction of $MoO_4^=$, formed as a secondary reaction product in the first step. The reduction of molybdate proceeds in two steps, the first at –0.85V and the second at –1.75V vs. the 1M Pt (II)/Pt reference electrode. The first step shows an abnormally short transition time, attributable to a slow equilibrium. The second step corresponds to a diffusion-controlled reduction with n = 0.5, yielding a product of the empirical formula $Li_2Mo_2O_8$. (auth)

30453 INTERACTION OF COLOUR CENTRES AND DISLOCATIONS. Clark, C. D.; Crawford, J. H. (Univ. of Reading, Eng.). Advan. Phys.; 22: No. 2, 117-205(Mar 1973).

The extensive work on the interaction between color centers and related defects with dislocations and dislocation debris introduced by plastic deformation is reviewed. The various aspects treated include: (a) the enhanced radiation colorability by prior deformation; (b) radiation hardening, and photomechanical effects; (c) the effects of plastic deformation on radiation-induced defects. The primary methods for probing the defect structures and their distribution are optical measurements. Measurements of flow stress, internal friction, and photomechanical behavior are used to highlight dislocation behavior. The structures of extended radiation-induced defects as revealed by microscopic examination are also discussed. (auth)

30454 UNIFIED MODEL FOR ALL STAGES OF THE F-COLORING OF NaCl. Agullo-Lopez, F.; Jaque, F. (Universidad Autonoma, Madrid). J. Phys. Chem. Solids; 34: No. 11, 1949-1960(Nov 1973).

A unified model for the F-coloring of NaCl is proposed which accounts for some of the important features of the coloring curve as well as its dependence on a number of factors. The model assumes the creation of anionic Frenkel pairs as the primary mechanism of damage. Then, the rate of F coloring is determined by the competition of secondary thermally activated processes that include trapping of the free interstitial by impurities (or lattice defects) and aggregation to other free interstitials or already-formed interstitial clusters. This model is obviously an oversimplified one and cannot account for all features found in the irradiation coloring of alkali metal halides. However, it provides a simple useful scheme that satisfactorily explains the behavior of NaCl, and probably some other alkali halides (particularly KCl) in a rather wide range of experimental conditions. Special attention has been paid to the shape of the curve and its modification by impurities, radiation intensity, and temperature. Some of the important characteristics of these effects have now been qualitatively explained. The use of a computer to solve the kinetic equations of the model yields curves that are quite similar to the experimental ones and permits the simulation of a number of experiments. In some cases semiquantitative agreement with experiment is obtained. (auth)

30455 RESISTANCE TO CRACK PROPAGATION IN CERAMICS SUBJECTED TO THERMAL SHOCK. Gupta, T. K. (Westinghouse Research Labs., Pittsburgh). J. Mater. Sci.; 8: No. 9, 1283-1286 (Sep 1973).

It is shown that the resistance to crack propagation in alumina, zirconia, and porcelain, when subjected to thermal shock, is high when the initial strength is low and, vice versa, when the initial strength is high. It is proposed that the high resistance to crack propagation results from discrete microcracking in the highly stressed zone ahead of the major crack, whereas the low resistance results from the unrestrained propagation of major cracks. Evidences of the crack patterns in alumina and zirconia substantiate this hypothesis. (auth)

30456 DEFECT EQUILIBRIA FOR EXTENDED POINT DEFECTS, WITH APPLICATION TO NONSTOICHIOMETRIC CERIA. Land, P. L. (Aerospace Research Labs., Wright-Patterson AFB, OH). J. Phys. Chem. Solids; 34: No. 11, 1839-1845(Nov 1973).

The dependence of electronic conductivity and composition of ceria on oxygen pressure is described by equilibrium equations for a material containing oxygen vacancies, divacancies, cerium interstitials, and polarons, where these defects are considered to include distorted zones of material. The analysis takes the extension of simple "point defects" into proper account, whereas earlier analyses have not. It is concluded that available data can be explained by polarons in equilibrium with isolated oxygen vacancies, but not with divacancies or interstitial cerium ions. (auth)

30457 MEASUREMENT OF STORED ENERGY OF KCl AFTER 4.6°K REACTOR IRRADIATION. Cruz-Vidal, B. A.; Boening, K.; Vogl, G. (Technische Univ. Munich, Garching, Ger.). J. Phys. Chem. Solids; 34: No. 11, 1909-1916(Nov 1973).

Five KCl single crystals were irradiated at 4.6°K in the core of the Munich Nuclear Reactor for periods of 100 sec, 10 min, 1 h, or 10 h, respectively. After irradiation, the stored energy of the samples was measured in a differential-heat-flow calorimeter at two different heating rates: 0.29 and 1.1°K/min. At 0.29°K/min, peaks of stored energy release were resolved at 21°K, near 27.5°K, at 32.5°K, at 42.5°K, and near 50°K. An attempt was made to evaluate the corresponding activation energies using two different methods. The annealing stages at 21 and 32.5°K correspond to first-order kinetics. The annealing stages at 42.5 and near 50°K are not of first order. A similar experiment was performed on KBr single crystals and is reported in a previous paper (Cruz-Vidal et al., J. Phys. Chem. Solids; 34: 1335(1973)). The results are compared with annealing studies on low-temperature x-irradiated KCl and KBr crystals. From both experiments it follows also that, during reactor irradiation at 4.6°K, ionization mechanisms of defect production should be responsible for the four observed low-temperature recovery peaks; only defect recovery at higher temperatures may be at least partially explained by recombination of collision-produced defects, i.e., the typical neutron-irradiation effect as it takes place in metals. (auth)

30458 CONSTITUTION OF TERNARY TITANIUM–TUNGSTEN–CARBON ALLOYS. Rudy, E. (Oregon Graduate Center, Beaverton). J. Less-Common Metals; 33: 245-273(1973).

The ternary alloy system Ti–W–C was investigated by means of melting-point, differential–thermoanalytical, x-ray-diffraction, and metallographic techniques on hot-pressed and heat-treated, as well as melted, alloy specimens and a phase diagram from 1500°C through the melting range was established. Above 2530°C, titanium monocarbide and the isomorphous cubic high-temperature phase in the W–C binary system are completely miscible and the solid solution has a congruent (maximum-type) melting point of 3130°C at the approximate composition $(Ti_{0.54}W_{0.44})C_{0.75}$. Below 2530°C, the tungsten exchange in the cubic monocarbide is temperature-dependent and decreases to about 50 at.% at 1400°C. The titanium exchange in W_2C is less than 3 at.% at 1500°C and reaches a maximum of 8 at.% at 2680°C. In addition to the ternary congruent melting point, four reaction isotherms occur in the system: two are pseudobinary eutectics, monocarbide + graphite at 3030°C, and monocarbide + tungsten-rich metal alloy at 2700°C; peritectic melting of the binary WC results in a class II reaction L + C ⇌ cubic monocarbide + $WC_{(hex)}$ at 2760°C, and a fourth isotherm at 2680°C is associated with a ternary eutectic between metal, monocarbide (B1), and W_2C. Pseudobinary eutectic melting between the monocarbide and the metal phase is directly attributable to the large stability difference between titanium and tungsten carbide, and the measured tie line distribution in the two-phase range metal + monocarbide is in accordance with estimates from known thermodynamic values for the binary boundary phases. The phase behavior is pseudobinary monocarbide solutions is largely determined by the relative lattice size of the boundary carbides, except for systems $(M,W)C_{1-x}$(M = Ti, Zr, Hf, V), which show extra stabilization due to bonding effects. (33 references) (auth)

30459 COMPOSITION OF THE EUROPIUM HEXABORIDE PHASE. Schwetz, K.; Lipp, A. (Elektroschmelzwerk, Kempten, Ger.). J. Less-Common Metals; 33: 295-303(1973). (In German).

With the help of electron beam microanalysis the composition of the europium hexaboride phase in hot-pressed and arc-melted samples was analyzed. Furthermore, the laitice-parameter data as a function of composition for this phase were determined. It was found that the homogeneity range of the nonstoichiometric phase, $Eu_{1-x}B_6$, extends from $Eu_{0.90}B_6$ to EuB_6; the cell parameter increases with the metal deficiency from a_0 = 4.1780 Å (at x = 0) to a_0 = 4.1843 Å (at x = 0.10). (auth)

30460 QUESTIONS CONCERNING THE EXISTENCE OF ERBIUM HEXABORIDE: THE CRYSTAL STRUCTURE OF $(Er_{0.8}Ca_{0.2})B_6$. Nichols, M. C. (Sandia Labs., Livermore, CA); Mar, R. W.; Johnson, Q. J. Less-Common Metals; 33: 317-320 (1973).

A single-crystal study was performed to isolate factors that might explain the difficulty experienced by some with synthesizing ErB_6. The starting materials were erbium sponge and rhombohedral boron. A 0.05-mm fragment of one of the crystals was used. Calcium impurity was present in the sponge and in the boron. Least-squares refinements based on a CaB_6-type structure did not proceed normally, suggesting erbium deficiency or impurity substitution. When 4 wt% calcium was used, least squares proceeded in a more normal fashion. The presence of calcium and its role in determining the lattice parameter was demonstrated, but unexplainable. It was found that calcium in the amount of 1 to 4 wt.% is not sufficient for complete stabilization, but when 10 wt% calcium was added to the starting materials, the hexaboride phase could be synthesized directly by arc melting. Although it is possible that the hexaboride crystal studied may have been stabilized by a metal vacancy mechanism, Ca substitution was sufficient to explain all of the data. (MCW)

30461 EFFECT OF CaO CONCENTRATION ON THE CREEP OF CaO-STABILIZED ZrO_2. St. Jacques, R. G.; Angers, R. (Laval Univ., Quebec). Trans. J. Brit. Ceram. Soc.; 72: No. 6, 285-289(Sep 1973).

The effect of CaO concentration on the compressive creep of CaO-stabilized ZrO_2 (CSZ) was studied between 13 and 20 mole % CaO. Polycrystalline specimens with grain diameters from 7 to 29 μm were studied for creep rate at temperatures between 1200 and 1400°C under stresses of 500 to 4000 lb/in^2. The creep rate is maximum for CSZ containing 15 mole % CaO. For specimens with <15 mole % CaO, lower creep rates were observed that can be related to the precipitation of tetragonal ZrO_2 in the grain boundaries. The lower creep rate of specimens containing >15 mole % CaO can be explained by a relaxation of the atomic lattice caused by the increasing concentration of O vacancies when the CaO concentration increases. (auth)

30462 COMPOSITE INSULATORS FOR USE IN HOT HYDROGEN ENVIRONMENTS. Riley, R. E.; Taub, J. M. (To United States Atomic Energy Commission). US Patent 3,740,340. 19 Jun 1973. Filed date 3 Mar 1971. 10p.

A description is given of insulators comprising composites of the composition $MC-M'O_2$ where M and M' may be Ti, Zr, Hf, V, Nb, Ta, Th, and U, and the metal carbide content may readily range from approximately 25 to 75 volume percent, have low thermal conductivities, and adequate structural properties when maintained at temperatures as high as 2300°C for as long as 16 hours in a flowing hydrogen environment. The designation $MC-M'O_2$ is a general one and does not necessarily imply a stoichiometric monocarbide and/or dioxide. (auth)

30463 CHEMICAL VAPOR DEPOSITION OF HAFNIUM CARBIDE. Kaplan, R. B. (Ultramet, Pacoima, CA). pp 176-182 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Some of the practical aspects of the deposition of hafnium carbide are discussed. A brief investigation of the thermochemistry shows that it is possible to deposit HfC at temperatures as low as 1300°C This is experimentally confirmed, and the procedure used for deposition of HfC from hafnium chloride and methane is outlined. (9 figures) (auth)

30464 GRADED CVD ZrC COATINGS FOR LOW-THERMAL-EXPANSION SUBSTRATES. Harris, R.; Kelly, E.; Leeds, D. H.; Kotlensky, W. V. (Super-Temp Co., Santa Fe Springs, CA). pp 183-193 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Considering the general "rule-of-thumb" that a coating will adhere to a substrate if the thermal expansion (CTE) mismatch is no greater than 25%, a graded scheme was worked out for coating low-thermal-expansion substrates (carbon) with CVD ZrC. The number of layers required in the graded coating are determined by the thermal expansion mismatch between substrate and stoichiometric ZrC. The analysis of layer thickness requirements and the approach employed in grading the CTE in adjacent layers are described. (7 figures) (auth)

30465 METHODS OF PREPARATION AND PROPERTIES OF INDIUM NITRIDE DEPOSITS. Samsonov, G. V.; Andreeva, A. F.; Bolgar, A. S.; Gordienko, S. P. (Inst. for Problems of Materials Science, Kiev). pp 194-199 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

The properties of indium nitride obtained by reactive sputtering are presented. The optical and electrophysical properties of the indium nitride are investigated (electrical resistivity ρ, Hall constant R, and Seebeck coefficient α) as a function of the concentration of nitrogen in the reactive gas mixture and of temperature. Indium nitride has a semimetallic behavior — low values of Hall constant (10^{-2}cm^3/coulomb) and electrical resistivity (1×10^{-1} ohm–cm). The concentration dependence of ρ, R, and α, as well as the composition of the vapor during evaporation, point to a region of homogeneity. The properties of indium nitride differ from the properties of the nitrides of the III B subgroup. The interruption of the monotonic change of properties in the series BN–AlN–GaN–InN is explained by the electronic configuration model for these materials. (auth)

30466 CHEMICAL VAPOR DEPOSITION OF METAL OXIDES FROM ORGANOMETALLICS. Hough, R. L. (Hough Lab., Springfield, OH). pp 232-241 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Methods for the chemical vapor deposition of oxides include the controlled oxidation of vaporized 2,4 pentanedianato metal compounds or the hydrolysis of metal halide vapor. Generally, these methods result in slow vapor deposition rates because of relatively low vapor pressure or premature decomposition of the precursor compound. The utilization of the more volatile metal alkoxides partially offsets these problems. Deposition of ZrO_2 and Al_2O_3 is reported. (8 figures) (auth)

30467 CERIUM OXIDE FILMS FROM A CHLORIDE SOURCE. Taylor, H. L.; Trotter, J. D. (Univ. of Texas, Austin). pp 475-480 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

CVD of cerium oxide films on silicon from a cerium chloride

source produced structures suitable for electrical evaluation. The two-zone diffusion-tube furnace used for the processing limited the flow patterns and injection geometries. Operation at 40-torr pressure for O_2 oxidation of sublimed $CeCl_3$ provided a 30% yield of "smooth" insulating films. Preferred reaction chains apparently include the Ce_2O_3 form. Precise control of stoichiometry was difficult in the furnace tube system. Conduction and capacitance measurements indicate a significant density of donor and acceptor states within the insulator. (auth)

30468 CERMET RESISTORS FROM CVD COATED PARTICLES. Pleass, C. M.; Schimmel, D. G. (Bell Telephone Labs., Inc., Reading, PA). pp 513-535 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

A description is given of cermet resistors made from metal-coated powders prepared by both wet and dry fluid bed CVD techniques. Sintered resistive bodies were produced from tungsten- and molybdenum-coated aluminum oxide powders with particle sizes ranging from 1 to 125 μm. SEM photographs are presented which demonstrate a basic process limitation in which the metal films break up at sintering temperatures as a consequence of inadequate wetting of the substrate. If one accepts partial breakup of the film, cermets in almost any resistivity range can be made. The conductive paths through them correspond to myriad randomly directed filaments of metal. In the configuration used it proved impracticai to reproduce them in the 1-10Ω range to better than $1\sigma = 30\%$ (12 ohm) and $1\sigma = 60\%$ (1 ohm) but this scatter is believed to be dominated by the mechanical instability of the contacts. In general, forming contacts to these materials is difficult if stability at high temperatures is a requirement. The problems experienced are not intractable. Interfacing with reactive metals such as Ti could be used to inhibit the breakup of the CVD metal films, and coexpansive contacts could be developed. (4 tables, 10 figures) (auth)

30469 VAPOR DEPOSITION OF HIGH-STRENGTH–HIGH-MODULUS BORON ON A CARBON MONOFILAMENT SUBSTRATE. Mehalso, R. M.; Diefendorf, R. J. (Rensselaer Polytechnic Inst., Troy, NY). pp 552-560 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Carbon monofilament was investigated as a possible substrate material to replace conventional tungsten now used in producing boron filament. Difficulty in depositing boron on carbon was traced to substrate fracture during deposition. To eliminate carbon substrate fracture, the elongation of the boron and the creep properties of the carbon substrate were studied during deposition. By matching the boron elongation and the carbon creep, boron filament with tensile strength in excess of 500,000 psi have been obtained. (7 figures) (auth)

30470 GRAPHITE–BORON NITRIDE SOLID SOLUTIONS BY CHEMICAL VAPOR DEPOSITION. Badzian, A. R.; Appenheimer, S.; Niemyski, T.; Olkusnik, E. (Inst. of Physics, Warsaw). pp 747-753 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Chemical vapor deposition of crystalline phases in the ternary boron–carbon–nitrogen system was investigated. Gaseous mixtures of BCl_3, CCl_4, nitrogen, and hydrogen were reacted on high-frequency heated graphite substrates. The resulting polycrystalline deposits were studied by means of x-ray diffraction. Samples of various compositions were classified as substitutional solid solutions in the graphite–hexagonal boron nitride system. The ternary boron–carbon–nitrogen phase has the distorted layer structure. In the layers the pairs of boron–nitrogen and carbon–carbon atoms are randomly distributed in the two-dimensional hexagonal lattice. Stacking of the layers has the graphite-like sequence. (auth)

30471 URANIUM. Williams, R. M. (Dept. of Energy, Mines, and Resources, Ottawa). Can. Mining J.; 94: No. 2, 100-104(Feb 1973).

The status of the Canadian uranium industry is briefly surveyed in context with the world situation in 1972. It is reported that Canadian production remained unchanged over the previous year. Denison Mines and Rio Algom operating in the Elliot Lake region of Ontario were the major producers while Eldorado Nuclear in Uranium City, Saskatchewan produced the remaining uranium oxide. Exploration in Canada in 1972 was minimal, although one orebody in northern Saskatchewan was confirmed. Exploratory activity in the United States also declined during the period covered by the survey. In contrast, exploration in Australia was carried out at record proportions. Questions relating to the construction of new enrichment facilities were studied extensively by several countries and corporations. Marketing activity in Canada was highlighted by a contract with several Spanish utilities involving 8.9 million pounds of U_3O_8 over a period of three years. Internationally, market activity was brisk with several sales being confirmed particularly with Japanese utilities. The future outlook does not seem to be unpredictable and any increased production must await the construction of enrichment facilities and the depletion of current stockpiles. (CA)

30472 MAGNETIC PROPERTIES OF THE COMPOUND UPTe. Zygmunt, A.; Czopnik, A. (Inst. for Low-Temperature and Structure Research, Wroclaw). Phys. Status Solidi (a); 18: No. 2, 731-734(16 Aug 1973).

A new compound of the composition UPTe, belonging to the UXY group compounds (X = pnictide, Y = chalcogenide) was obtained. It is assigned to the crystal structure of the type UGeTe (space group $14/mmm\text{-}D_{4h}^{17}$). Magnetic investigations performed on single-crystal and powder specimens in the temperature range 4.2 to 1000°K show that it constitutes an uniaxial ferromagnet with a Curie temperature of 85°K. In the measured paramagnetic range the dependence $\chi_g^{-1} = f(T)$ deviates from the Curie–Weiss law, which is explained by a strong crystal field. (auth)

30473 PREPARATION OF TRANSPARENT ZIRCONIUM DIOXIDE IN HIGH-TEMPERATURE SOLAR PLANT. Lidorenko, N. S.; Chizhik, S. P.; Shermazanyan, Ya. T.; Shakparonyan, V. V.; Efimovskaya, T. E.; Lanin, A. A.; Lyutsareva, L. A.; Shumanova, S. P. Izv. Akad. Nauk Arm. SSR, Ser. Tekh. Nauk; 25: No. 4, 10-14(1972). (In Russian).

The results of studies made on the preparation of transparent material based on stabilized zirconium oxide by means of melting in high-temperature direct-tracking solar furnaces with a sesquimetric concentrator are described. The structure of the material obtained is more perfect than that obtained by the sintering method. The density is close to theoretical. Purification from impurities occurs. (tr-auth)

30474 NEW DATA ON THE STATE OF THE METAMICT BRANNERITE BEHAVIOR DURING THERMAL TREATMENT. Krivokoneva, G. K. Zap. Vses. Mineral. Obshchest.; No. 5, 254-257(May 1972). (In Russian).

Results of the x-ray study of two metamict brannerites, the products of high- and low-temperature hydrothermal processes, are discussed. It was found that the behavior of both samples in the annealing process is principally alike. It was established that, during annealing in vaccum at 600°C, structures are formed of the same type as in the original submetamict structure of the brannerite, but in the annealing processes of the mineral in air, phase conversions caused by the oxidation and reduction of uranium appear. At 600°, the structure of brannerite begins to form. Then as a result of the oxidation of uranium together with brannerite U_3O_8 and rutile (700°), U_3O_8, TiO_2 (rutile), "phase x" (800 to 900°), and "phase x" (900 to 1000°) are formed. At temperatures above 900 to 1000°, uranium is again reduced to U^{4+}. At 1100°, brannerite, U_3O_8, and rutile are formed. At 1200°, pure brannerite is formed. "Phase x" probably has the composition UTi_2O_6 and crystallizes in the structure type U_3O_8–UTa_2O_8. (tr-auth)

30475 CRITICAL ACOUSTIC RELAXATION IN EuO. Golding B. (Bell Telephone Labs., Murray Hill, NJ); Barmatz, M.; Buehler, E.; Salamon, M. B. Phys. Rev. Lett.; 30: No. 20, 968-971(14 May 1973).

Acoustic damping and dispersion in EuO were measured at low kilohertz frequencies near the ferromagnetic critical point. The observations are discussed in terms of thermoelastic and critical dissipative processes. Bounds are established for the critical relaxation rate for sound, $2 \times 10^5 < \tau_c^{-1} < 2 \times 10^7$ sec^{-1}, in order-of-magnitude agreement with the EuO spin–lattice relaxation rate calculated by Huber. (auth)

30476 INVESTIGATION OF THERMODYNAMIC PROPERTIES OF VANADIUM MONONITRIDE. Kozheurov, V. A.; Zhikharev, V. M.; Shishkov, V. I. (Chelyabinsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 12, 76-80 (Dec 1972). (In Russian).

On the basis of the thermodynamic theory of nonstoichiometric compounds with consideration of the defects of their structure and the indistinguishability of ions (atoms) of different valences, experimental results of the dependence of elasticity in dissociation of VN on the composition and temperature are analyzed. Ex-

pressions are obtained for the chemical potential of nitrogen in the nitride and a verification of their applicability is made. The values of the coefficients in expressions for calculation of some thermodynamic properties as a function of composition in the temperature interval from 1300 to 1650°C are reported. (tr-auth)

30477 ZIRCONIUM OF SLYUDYANKA. Kalinin, P. V.; Lipova, I. M. (Moscow Geological Inst.). Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 1, 58-67(Jan 1973). (In Russian).

The zircons of Slyudyanka occur in three types: (1) crystalline, (2) polymetamict, and (3) metamict. They are distinguished by the concentration of uranium, determination of α radiation, specific weight, birefringence, quantity of reflection in the Debye gamma, ir absorption spectra, and character of the annealing products. The concentration of uranium in these zircons increases from the crystalline (0.040 to 0.048% U) to the metamict variety (0.6% U); in the polymetamict it is 0.17 to 0.20% U. The concentration of thorium in the crystalline zircon is 0.012 to 0.038% and in the polymetamict it is 0.035 to 0.039%. The ratio Th/U decreases from the crystalline to the metamict zircon. The total amount of α radiation, calculated by the increase of α activity on the absolute age of the mineral (550 million years), increases from 1.5×10^{14} α/mg for crystalline zircon to 9.2×10^{15} α/mg for metamict. The quantity of α radiation of polymetamict zircon has an intermediary value of 3.5×10^{15} α/mg. It was taken into consideration that the radioactive emission is the principal reason of the metamict decay of zirconium. Data on the chemical composition of the Slyudyanka zircon, selected from different types of samples, indicate that they do not have a very sharp variation in chemical composition. The concentration of those elements such as Zr, Hg, U, Th, Sc, and H_2O and the α activity in zircons of different genesis vary within some limits, but this change is not subject to any regularities. At the same time the composition of the zircons is well correlated with the degree of metamicticity (decrease of the ZrO_2 concentration, increase of the U concentration and amount of α radiation from the crystalline to the metamict varieties). (tr-auth)

30478 NATURE OF METAMICT ZIRCONS. Lipova, I. M.; Semenov, E. I. Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 6, 50-57(Jun 1972). (In Russian).

On the basis of mineralogical studies of zircon, malacon, cyrtolite, albite, naegite, oerstedite (60 samples in all) it was established that they form a series of zircons, differing by the degree of metamicticity and by the concentration of admixtures. All series of zircons were conditionally separated into crystalline, polymetamict, and metamict. At the limits of these groups the varieties of zircon with increased concentration of impurities (above 5 at. %) were separated. For deposits of metamict zircon, enrichment by heavy amphoteric elements (U, Th, Nb, Ta) was characteristic, while a number of those capable were oxidized (U, Fe). Results of a detailed study of the zircon series indicate that among the most significant factors causing metamictic decay of the mineral is the radioactive radiation of uranium and thorium. The structural requirement for transition of the mineral to the metamict state is the initial defect of the crystal associated with the high concentration of impurities in the zircon. The temperature for the onset of the formation of the $ZrSiO_4$ phase in the metamict zircon increases with increase of the degree of metamicticity of the mineral from 600 to 1300°C. The intensity of the coloration is not correlated with the amount of α radiation and the age of the zircon. Luminescent analysis can be used for commercial evaluation of concentration only for crystalline zircon, since the metamict type does not luminesce either in the natural or in the annealed state. (tr-auth)

30479 PROCESS FOR THE PREPARATION OF URANIUM NITRIDE POWDER. Potter, R. A.; Tennery, V. J. (to United States Atomic Energy Commission). US Patent 3,758,669. 11 Sep 1973. Filed date 23 Nov 1971. 8p.

A process is disclosed for the preparation of finely divided uranium nitride, (uranium, plutonium) nitride, americium nitride or neptunium nitride by incrementally dehydriding the corresponding metal hydride and nitriding the dehydrided increment. The process is carried out in a cyclic manner until all of the metal hydride has been converted to metal nitride. (auth)

30480 METHOD OF MAKING URANIUM DIOXIDE BODIES. Wilhelm, H. A.; McClusky, J. K. (to United States Atomic Energy Commission). US Patent 3,761,564. 25 Sep 1973. Filed date 22 May 1972. 6p.

Sintered uranium dioxide bodies having controlled density are produced from U_3O_8 and carbon by varying the mole ratio of carbon to U_3O_8 in the mixture, which is compressed and sintered in a neutral or slightly oxidizing atmosphere to form dense slightly hyperstoichiometric uranium dioxide bodies. If the bodies are to be used as nuclear reactor fuel, they are "subsequently heated in a hydrogen atmosphere to achieve stoichiometry. This method can also be used to produce fuel elements of uranium dioxide–plutonium dioxide having controlled density. (Official Gazette)

30481 PRODUCTION OF PREDOMINANTLY CRYSTALLINE SOLS. McBride, J. P.; McCorkle, K. H.; Pattison, W. L. (to United States Atomic Energy Commission). US Patent 3,758,670. 11 Sep 1973. Filed date 1 Aug 1969. 10p.

A method is described for forming a stable, predominantly crystalline sol from an acid-deficient solution of a hydrous metal oxide in which the metal is in the +4 oxidation state. The solution is heated to a crystallizing temperature to cause an increase in conductivity and remove anions at the crystallizing temperature to a condition of further acid deficiency at a rate which approximates the rate of release of free acid to the aqueous phase of the resultant sol. The anion-to-metal ratio of the sol is then adjusted to the desired state. (Official Gazette)

30482 DISPERSED SYSTEMS AS COMMERCIAL MATERIALS FOR AEROSPACE APPLICATION. Bunk, W. J. Metals; 25: No. 5, 26-32(May 1973).

Development and uses of composite and dispersed materials in jet engines, aircraft, spacecraft, space shuttles, satellites, and high temperature environments are reviewed. Information is included on fibers, ceramic whiskers, eutectics, and hardened alloys. (JRD)

30483 ELECTRICAL PROPERTIES OF In_2O_3. De Wit, J. H. W. (Univ. of Utrecht). J. Solid State Chem.; 8: No. 2, 142-149(Oct 1973).

Conductivity data for In_2O_3 both from literature and from new measurements are critically compared. They are correlated with atmospheric conditions and temperature. The conductivity data and structural considerations lead to the conclusion that nonstoichiometric In_2O_3 is an n-type semiconductor. Interstitial indium ions are probably the predominant defects. (auth)

30484 VIBRATIONAL SPECTRA OF COMPOUNDS Ln_2MoO_6 AND Ln_2WO_6. Bode, J. H. G.; Kuijt, H. R.; Lahey, M. A. J. T.; Blasse, G. (Solid State Chemistry Dept., Utrecht). J. Solid State Chem.; 8: No. 2, 114-119(Oct 1973).

The vibrational spectra of compounds Ln_2WO_6 and Ln_2MoO_6 (Ln = lanthanide, including Y and Bi) are reported. Neglecting details it is possible to assign the internal vibrations of the molybdate and tungstate group. The results are in agreement with known structural data and suggest further that tungsten in the unknown Y_2WO_6 structure is in six-coordination, that Bi_2MoO_6 shows still another modification that koechlinite and that vibrational spectroscopy may yield additional structural information for compounds like those under consideration. (auth)

30485 MATRIX ISOLATION STUDIES ON THE GALLIUM–INDIUM–OXYGEN SYSTEM. Infrared Spectra and Structures of Molecular Ga_2O, In_2O, and InOGa. Hinchcliffe, A. J.; Ogden, J. S. (Oxford Univ.). J. Phys. Chem.; 77: No. 21, 2537-2544 (11 Oct 1973).

When the vapor above heated gallium oxide is condensed in low-temperature matrices, two oxide species are frequently produced and these are identified by infrared spectroscopy as Ga_2O and a dimer species Ga_4O_2. The same molecules are also observed when oxygen gas is passed over heated gallium and the products are similarly isolated. The corresponding indium–oxygen system yields analogous species In_2O and In_4O_2, and when oxygen is passed over an alloy of gallium and indium, several new mixed species of the general formula $Ga_xIn_{4-x}O_2$ are identified in addition to the mixed metal suboxide InOGa. Infrared band assignments are supported by diffusion studies and the use of ^{18}O enrichment, and normal coordinate analyses for Ga_2O and In_2O yield principal force constants $F_{Ga-O} = 3.65 \pm 0.2$ mdyn/Å and $F_{In-O} = 3.15 \pm 0.25$ mdyn/Å and apex angles $\geq 142°$ and $\geq 135°$, respectively. The interpretation of these results is discussed in the context of previous work on these systems. (auth)

30486 INFLUENCE OF IRON IMPURITIES ON THE REVERSIBLE COLORATION OF MoO_3, Nb_2O_5, AND TiO_2. Coey, J. M. D.; Deb, S. K.; Regnard, J. R. (Centre National de la Recherche Scientifique, Grenoble, France). pp 34 of Hyperfine Interactions Detected by Nuclear Radiation. Liege; Univ. Liege (1973). (In French).

From hyperfine interactions detected by nuclear radiation;, Liege, Belgium (11 Sep 1973).

Samples of these three oxides doped with 0.5% $^{57}Fe_2O_3$ were studied by Moessbauer spectroscopy and optical reflectivity. The charge state of the iron is 3+ for complete oxidation of the compounds and 2+ in the reduced samples. The blue color resulting from heating under vacuum or from uv radiation is deeper in the

doped samples. A diagram is proposed for the energy levels that explains this behavior. (tr-auth)

30487 EFFECT OF SILICON ON FORMATION OF BORIDE COATINGS. Permyakov, V. G.; Yakovchuk, Yu. E.; Cherepin, V. T.; Amirkhanova, T. V.; Maifet, Yu. P. (Kiev Polytechnic Inst.). Metal Sci. Heat Treat. (USSR) (Engl. Transl); 15: No. 3-4, 251-253(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 3-4, 67-68(1973).

The characteristics of diffusion boride coatings on iron–silicon alloys were investigated. Samples were borided in molten borax using boron carbide at 850 to 950°C for 2 to 10 h. Results show that in the process of boriding, silicon is forced into the transition zone and has an inhibiting effect on the growth of the high-boron phase (FeB) and the layer of borides, leading to a change in the phase composition of this zone. (JRD)

30488 SATURATION OF STEEL Kh18N10T WITH MOLYBDENUM FROM THE VAPOR PHASE. Dymchenko, V. V.; Griboedov, Yu. N.; Bogatyrev, Yu. M. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 3-4, 197-200(1973).

Translated from Metalloved. Term. Obrad. Metal.; 15: No. 3-4, 17-21(1973).

The structure of Mo diffusion coatings on Kh18N10T steel were investigated. It was found that under certain conditions of coating steel Kh18N10T with molybdenum from the vapor phase, the diffusion coating has a structure characteristic of reaction diffusion in the initial stage of the process. With an increase of the processing time an interlayer of α phase appears in the molybdenum coating, in conformity with the molybdenum–austenitic steel phase diagram. By calculation of the balance of molybdenum mass transfer at the interface and investigation of the structure of the diffusion coating it was found that the reaction mechanism of diffusion is due to the value of the ratio of external mass transfer to internal mass transfer and to the thermodynamic factor. Growth kinetics of the α phase in the molybdenum coating was investigated. The growth rate is characterized by a parabolic law and is limited by the diffusion of molybdenum through the layer of Fe_3Mo_2. The diffusion coefficient of molybdenum in α phase was calculated. It was found that there may be an advantage in the structure of the molybdenum coating obtained under conditions of reaction diffusion, which can be used to develop means of protecting austenitic steels against corrosion. (auth)

30489 INFLUENCE OF CERTAIN FACTORS ON THE KINETICS OF DECOMPOSITION OF URANIUM OXYCARBIDES. Vlasov, V. G.; Larin, A. A. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 4, 755-758(Apr 1973).

Translated from Zh. Prikl. Khim.; 46: No. 4, 705-708(Apr 1973).

Results of studies are reported on the effects of temperature, reaction-mixture particle size distribution, specimen density, and gas pressure on thermal stability of uranium oxycarbide. It was found that the decomposition rate increases with temperature. The decomposition proceeds with formation of metallic uranium and of carbon monoxide. The rate of dissociation of uranium oxycarbides is lowered by increase of tablet fabrication pressure, increase of dispersity, increase of the gas phase pressure in the reaction space, and increase of the thickness of the layer of the powdered reaction mixture. The apparent activation energy varies from 31 to 42 kcal/mole, dependent on the oxycarbide composition. The stability of oxycarbide increases with decrease of oxygen content. This is probably due to ordering of the solid solution (uranium oxycarbide). (JRD)

30490 STEAM REFORMING CATALYST. Nicklin, T. (to Gas Council). British Patent 1,324,505. 25 Jul 1973. Filed date 21 Oct 1969. 4p.

Reference is made to catalysts for use in the steam reforming of methane. The catalyst described comprises a carrier on the surface of which is NiO and/or Ni, together with one or more oxides of U (usually U_3O_8 or UO_2). The ratio of U to Ni present is less than 0.62 : 1 by weight, and the total weight of Ni and U present on the carrier is not more than 10% by weight of the catalyst. The carrier material may comprise $\alpha-Al_2O_3$. K_2O or Li_2O, or compounds decomposable thereto on heating, may also be present, to the extent of 0.05 to 0.15% by weight. Details are given for production of the catalyst. Improved activity is claimed over catalysts at present used, and production is relatively inexpensive. (UK)

30491 METHOD OF PRODUCING GERMANIUM, TITANIUM, ZIRCONIUM, OR HAFNIUM MONOXIDES. Sukhanov, N. M.; Krikorov, V. S.; Krasov, V. G.; Kokin, V. K.; Shevchenko, B. I.; Yakovlev, B. Y.; Markelov, A. V.; Kolesnikova, I. A.; Sukhodaev, B. A.; Tverskov, V. A.; Gerasminov, A. D.; Rozhdestvenskii, V. N. British Patent 1,322,837. 11 Jul 1973. Filed date 13 Aug 1971. 3p.

The disadvantages of previous methods for the production of monoxides of Group IV elements are stated. A method is described for the production of GeO comprising mixing Ge with GeO_2 in the molar ratio of 1 : 1 to 1.3 : 1, sintering the mixture at 800 to 900°C, heating the sintered mixture in a vacuum at 800 to 900°C to evaporate the GeO, and condensing the GeO at 150 to 250°C. The sintering is preferably effected in air. The method may also be applied to the production of TiO, ZrO, and HfO with suitable temperature modifications. Detailed examples are given. (UK)

30492 MONOCHROMATIC EMITTANCE OF A TiC–ZrC SYSTEM. Kirillov, V. S.; Safonov, V. I.; Tychina, V. V. High Temp.; 10: No. 4, 814-816(Mar 1973).

The monochromatic emittance ($\epsilon_{\lambda=0.65}$) at 1800°K of a $(TiC)_x-(ZrC)_{(1-x)}$ system, where x = 0, 0.25, 0.5, 7.5, and 1 was determined. Specimens in the form of tablets of diameter 12 mm and thickness of 2.5 mm were fabricated by hot pressing in vacuum from zirconium and titanium monocarbide powders. The pressed tablets were polished with boron carbide. Pyrometric measurements were made on the side of the tablet so that the free emission from the surface could be compared with the emission from a hole simulating a blackbody. The hole drilled in the side of the tablet had a diameter/depth ratio of 1 : 10. According to previous data, the emittance of such a cavity is very close to unity (ϵ_λ = 0.995). The measurements were made in a vacuum of the order of 1 to 2×10^{-6} mm Hg. (LMT)

30493 CRITICAL MAGNETIC BEHAVIOUR OF EUROPIUM OXIDE. Hoeg, J.; Johansson, J. (Danmarks Tekniske Hoejskole, Lyngby). Int. J. Magn.; 4: No. 1, 11-16(Mar 1973).

By measuring M(H,T) for the insulating and nearly isotropic cubic ferromagnet EuO the following critical exponents and coefficients were obtained $\beta = 0.385^{+0.008}_{-0.028}$, $\delta = 4.35 \pm 0.1$, $\gamma = 1.315 \pm 0.015$, $\gamma' = 1.30 \pm 0.10$, $A = 1.255^{+0.030}_{-0.100}$, $B = 0.104 \pm 0.013$, $C_x^{-1} = 0.84 \pm 0.04$, and $D_x^{-1} = 0.30 \pm 0.10$. Within the experimental accuracy, it was found that the exponent γ' for the parallel susceptibility below T_c equals the exponent γ for the susceptibility above T_c. The magnetization was measured by means of a 5-Hz vibrating sample magnetometer, using kink point techniques supplemented by isothermal measurements. The Curie temperature T_c was found to be 69.2 ± 0.1°K. The susceptibility above T_c is compared with the recent calculation for the nearest neighbor Heisenberg model by D. S. Ritchie and M. E. Fisher (Phys. Rev. B.; 5: 2668 (1972)). (auth)

30494 ARC MELTING AND HOMOGENIZATION OF ZrC AND ZrC + B ALLOYS. Darolia, R.; Archbold, T. F. (Univ. of Washington, Seattle). Metallography; 6: No. 5, 433-438 (Oct 1973).

Methods used in arc-melting and homogenizing near-stoichiometric ZrC and ZrC-boron alloys are described. Particular attention was given to oxygen contamination mechanisms. The as-cast microstructure of ZrC was completely dendritic. The microstructure of the as-cast ZrC containing boron showed ZrB_2 precipitates throughout the carbide. Micrographs are included to illustrate microstructural features of the refractories. (JRD)

30495 OPTICAL DETERMINATION OF OH IN B_2O_3 GLASS. Pasteur, G. A. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Amer. Ceram. Soc.; 56: No. 10, 548(Oct 1973).

Optical determination of OH in B_2O_3 glass by measuring the molar extinction coefficient of the OH overtone band at 1.41 μm is described. The molar extinction coefficient of the 1.41-μm band, with corresponding values for the fundamental, combination, and overtone OH stretching vibration bands, is tabulated. The large inaccuracy of the measurement results for the combination bands at 2.40, 2.17, and 2.02 μm is caused by the steepness of the base line, which depends on the sample thickness, the concentration of OH, and the quantity of H_3BO_3 formed on the sample surface by absorption of atmospheric water. However, the 1.41-μm band was used for accurate OH determination in B_2O_3 glasses; the coefficient is given in a table. (JRD)

30496 RARE EARTH NIOBATE COMPOSITION. Ropp, R. C. (to Westinghouse Electric Corp.). US Patent 3,758,486. 11 Sep 1973. Filed date 13 May 1969. 4p.

Luminescent compositions of the system comprising yttrium, lanthanum, gadolinium niobate or combinations thereof, activated by selected rare earth metals are specified. The orthoniobate is the preferred composition and is provided by utilizing a 1 : 1 gram atom ratio of yttrium, lanthanum, and gadolinium to niobium. Luminescent compositions of the system are all excited by ultraviolet radiation with the emission characteristic depending upon the particular selected rare earth metal activator. (Official Gazette)

30497 KINETICS OF THE URANIUM–HYDROGEN SYSTEM. Condon, J.B.; Larson, E.A. (Nuclear Division, Union Carbide

Corporation, Oak Ridge, Tennessee 37830). J. Chem. Phys. 59: No. 2, 855-865 (15 July 1973).

The reaction kinetics of U + $3/2H_2 \rightleftharpoons UH_3$ was studied with fine powders on an ultrahigh-vacuum microbalance. The kinetics were found to be first order with respect to uranium for the hydriding reaction and nearly zero order with respect to uranium hydride for dehydriding. A new reaction mechanism is proposed to account for the experimental observations which involves diffusion in the reactant phase by hydrogen before nucleation to form the hydride phase. This reactant phase diffusion and phase transformation reaction with its associated solid state mathematics accounts for all the observations made to date on the kinetics of this system. (auth)

30498 PRESSURE DEPENDENCE OF ELASTIC MODULI OF TUNGSTEN CARBIDE CERMET. Day, J.P.; Ruoff, A.L. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14850). J. Appl. Phys. 44: No. 6, 2447-2448 (June 1973).

The elastic constants of a commercial tungsten carbide cermet (3% cobalt binder) were measured as a function of pressure at room temperature. As pointed out in a recent publication by Ruoff, the pressure dependence of the elastic constants affects the maximum possible pressure which a vessel can contain. This dependence is discussed in light of the present data. (auth)

30499 ELECTRONIC STRUCTURE OF VANADIUM CARBIDE. Zbasnik, J.; Toth, L.E. (University of Minnesota, Department of Chemical Engineering & Materials Science, Minneapolis, Minnesota 55455). Phys. Rev. B 8: No. 2, 452-459 (15 July 1973).

The electronic structure of stoichiometric vanadium carbide has been computed using the augmented-plane-wave (APW) method and the energy bands for nonstoichiometric phases have been determined with the APW-virtual-crystal approximation. The energy bands exhibit a very strong dependence on the relative sizes of the assumed APW-sphere radii for vanadium and carbon. Bands for the nonstoichiometric phases show a marked deviation from a rigid-band behavior as the composition is varied. The results of x-ray-emission, heat-capacity, magnetic-susceptibility, and Hall-effect measurements are discussed in terms of the computed bands. (auth)

30500 STUDY OF THE ELECTRONIC STRUCTURE OF REO_3 AND ITS PRESSURE DEPENDENCE BY THE KORRINGA-KOHN-ROSTOKER METHOD. Myron, H.W.; Gupta, R.P.; Liu, S.H. (Ames Laboratory-USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. B 8: No. 4, 1292-1295 (15 Aug 1973).

Energy bands of the simple cubic metallic compound rhenium trioxide have been calculated by using the Korringa-Kohn-Rostoker method. The crystal potential has been constructed in the muffin-tin approximation from overlapping atomic charge densities and full Slater exchange. As a result of the muffin-tin approximation, the rhenium d band comes out too narrow, but the band ordering and the Fermi-surface geometry agree well with the more elaborate calculations. The calculation has been done for both an equilibrium lattice and a compressed lattice, and the changes in Fermi-surface geometry have been investigated. It is found that the logarithmic derivatives of some de Hass-van Alphen frequencies with respect to pressure depart markedly from the free-electron scaling predictions, in agreement with the experimental results. (auth)

30501 THE NATURE OF SURFACE FISSION TRACKS IN UO_2. Ronchi, C. (EURATOM, Establishment of Karlsruhe, Institut für Transurane, Germany). J. Appl. Phys. 44: No. 8, 3575-3585 (Aug 1973).

Fission fragment tracks produced on prepared surfaces of uranium dioxide were observed by replica electron microscopy. Several statistical analyses and measurements were performed on the observed tracks to be compared with theoretical studies of a fission fragment passing through a stopping medium. A temperature distribution around the fragment is evaluated by applying the thermal diffusion model to the particle energy losses. Since the temperatures attained at the surface could not explain any track formation, a shock wave is shown to be a possible cause by considering processes due to thermal pressures engendered by the very hot core surrounding the fragment path. (auth)

Metals and Alloys

Refer also to abstracts 29776, 31808, 31817, 31908, 32137, 32140, 32146, 32148, 32153, 32161–32164, 32172, 32174, 32176, 32182–32185, 32188, 32191, 32192, 32200, 32203, 32208, and 32210.

30502 (ORNL-4870, pp 17-18) FUNDAMENTAL PHYSICAL METALLURGY. Vandermeer, R. A. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Phase transformations in uranium alloys (U–Nb–Zr and U–Ti) are being studied by means of dilatometry, x-ray diffraction, and optical microscopy. The cause of texture inhomogeneity in cold-rolled niobium is being sought. The relationship between the nature of the precipitated state and the alloy's electrical properties, strength, and radiation damage resistance is under investigation in aluminum alloys. (auth)

30503 (ORNL-4870, pp 37-38) HIGH-TEMPERATURE ALLOYS FOR ISOTOPIC HEAT SOURCES. Donnelly, R. G. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Iridium alloys containing up to 2 at.% Ru, Re, W, Nb, and Hf were studied in an effort to develop high-melting, high-strength, oxidation-resistant materials for space power applications to 1400°C. These alloying additions significantly raise the recrystallization temperature and high-temperature tensile properties, including toughness, with little or no impairment in oxidation resistance. Recently developed platinum alloys containing 26 to 30% Rh and 8% W continue to show good fabricability and strength; however, scale-up efforts have encountered some variability in fabrication behavior and mechanical properties, possibility resulting from difficulties in compositional control. A method for purifying and/or recycling iridium scrap involving high-temperature oxidation was developed. After acid treatments and hydrogen reduction to the metal, a powder assaying 99.98% Ir is produced. A variety of short-term tasks and consulting services were provided to SNS in connection with the Multi-Hundred Watt Thermoelectric Generator Project. (auth)

30504 GENERAL REVIEW OF SCIENTIFIC AND TECHNOLOGICAL ASPECTS OF THE UTILIZATION OF RE MATERIALS. Gscheidner, K. A. Jr. (Ames Lab., IA). pp 1-7 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

Major uses and some of the more promising potential applications of rare-earth materials are examined from a scientific and technological view. This has led to the subdivision of these applications into four groups; those uses based on the similar chemical nature of the rare earths, on the 4f electrons, on valence states different from +3, and on nuclear properties. In general, the mixed rare earths are used primarily in the first applications and the separated individual elements in the others, although some notable exceptions are found. The scientific bases for the various applications are briefly discussed. (auth)

30505 FUNDAMENTAL PROPERTIES OF RE ELEMENTS AND THEIR IMPLICATIONS ON THE ANALYTICAL CHEMISTRY OF RE MATERIALS. Gscheidner, K. A. Jr. (Ames Lab., IA). pp 9-24 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

Electronic configurations of the metallic state, ground state (gaseous atoms), and trivalent ions of the rare earth elements are given. The relationship between these configurations and the chemical and physical properties of the metals and some of the important compounds is discussed. A separate section is devoted to the spectra of the rare earth elements. Comments are made regarding the influence some of these properties have on various analytical techniques. (auth)

30506 THEORETICAL BASIS FOR THE USE OF RARE EARTHS IN OPTICAL AND LUMINESCENT MATERIALS. Blasse, G. (Rijksuniversiteit, Utrecht). pp 213-228 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

The energy level diagram of rare earth ions is first considered and the possible optical transitions and selection rules are presented and discussed. Broad-band as well as sharp-peak transitions are dealt with, and their relevancy to luminescent materials is indicated. Energy transfer from ions that absorb the exciting radiation strongly to rare earth ions that then show luminescence is discussed. Finally, the phenomenon of concentration quenching is introduced. (NO)

30507 MISCELLANEOUS USES OF RE MATERIALS (CERAMICS, GLASSES, NUCLEAR APPLICATIONS, ETC.). Gschneider, K. A. Jr. (Ames Lab., IA). pp 271-280 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

Following discussion of the uses of RE materials in ceramics and glasses, their use in the nuclear field is discussed. Their major use here is as control-rod materials and burnable poisons.

The advantage of Eu and Dy as control-rod material is that they form successive large cross-section isotopes. Gd and Sm, on the other hand, are attractive in shutdown and safety devices. Eu must be used in control rods in the trivalent state as the formation of Gd daughters could otherwise lead to a 30% volume contraction. Other applications are as fuel diluents, neutron radiography imaging devices, and as radioisotopes. (NO)

30508 PERMANENT MAGNETS BASED ON RE MATERIALS. Staeblein, H. (Krupp GmbH, Essen). pp 331-349 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

The magnetic properties of rare earth–cobalt alloys are far superior to those of conventional permanent magnet materials. The saturation polarization, Curie temperature, anisotropy field, and x-ray density of some such alloys are compared with those of Alnico, barium ferrite and PtCo. Two techniques for producing high-coercivity values are described. Powder-metallurgical production of high-grade permanent magnets is discussed, and the magnetic characteristics of several types, produced by different techniques, without and with copper, are presented. It is also shown how temperature influences the magnetic properties. Following a brief comparison of rare earth–cobalt permanent magnets with conventional permanent magnets, the direction of future developments is discussed. (NO)

30509 EVALUATION OF A CVD TUNGSTEN/GRAPHITE CRUCIBLE. Kyle, M. L.; Kolba, V. M.; Pierce, R. D. (Argonne National Lab., IL). pp 618-624 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Requirements for corrosion-resistant, lightweight, low-cost crucibles for pyrochemical processing vessels prompted the fabrication and testing of a crucible formed by chemical vapor-deposition of tungsten on graphite. Tungsten was the desired coating because of its corrosion resistance; graphite was the desired substrate because of its low cost and thermal expansion characteristics that are compatible with tungsten. The tungsten-coated graphite crucible was evaluated under process conditions at temperatures up to 900°C. Molten metals (Zn, Zn–Mg and Cu–Mg alloys), and molten salts ($MgCl_2$–NaCl–KCl and $CaCl_2$–CaF_2 eutectic mixtures) were successfully contained for 300 hr. After testing the vessel was structurally sound although some spallation of the coating was noted. (auth)

30510 SUMMARY OF APPLICATIONS FOR CVD COMPONENTS IN DIRECT ENERGY CONVERSION DEVICES. Rouklove, P. (Jet Propulsion Lab., Pasadena, CA); Glaski, F. A. 647-657 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

A review is given of the application of CVD to the manufacture of electrodes for thermionic energy conversion devices. Emphasis is given to the two materials most used in the manufacture of the emitters: tungsten and rhenium. Deposition parameters and post-deposition surface treatments are discussed. Performance data for converters assembled with rhenium electrodes are presented. (6 figures, 29 references) (auth)

30511 FABRICATION AND EVALUATION OF CHEMICALLY VAPOR DEPOSITED TUNGSTEN HEAT PIPES. Bacigalupi, R. J. (Louis Research Center, Cleveland). pp 659-664 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

A network of lithium-filled tungsten heat pipes is being considered as a method of heat extraction from high-temperature nuclear reactors. The need for material purity and shape versatility in these applications dictates the use of chemically vapor deposited (CVD) tungsten. Adaptability of CVD tungsten to complex heat pipe designs is shown. Deposition and welding techniques are described. Operation of two lithium-filled CVD tungsten heat pipes above 1800°K is discussed. (10 figures) (auth)

30512 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift, Transplutonium-Elemente. Halbjahresregister 1973. Band 7, Heft 1-6. (Plutonium-Documentation. Abstract Journal, Transplutonium Elements. Semiannual Index 1973. Vol. 7, No. 1-6). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). 132p. (In German and English).

30513 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift, Transplutonium-Elemente. August 1973. Band 7, Heft 8. 241 Referate (Register-Nr. 3222-3678), 91 Referate (Register-Nr. 540T-630T). (Plutonium-Documentation. Abstract Journal, Transplutonium Elements. August 1973. Vol. 7, No. 8. 241 Abstracts (Register No. 3222-3678), 91 Abstracts (Register No. 540T-630T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). 128p. (In German and English).

This listing includes 457 references. (LMT)

Corrosion and Erosion

Refer also to abstract 30487.

30514 (ORNL-4870, pp 26-27) SURFACE PHENOMENA. Cathcart, J. V. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Research on oxidation of U alloys with Nb and Zr is summarized. Results of a comparison of the ignition characteristics of Ta–10 wt % W and T-222 are given. (DLC)

30515 (ORNL-4870, pp 39-40) CURIUM-244 COMPATIBILITY TESTING. Donnelly, R. G.; DiStefano, J. R. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

A program to identify materials that are compatible with $^{244}Cm_2O_3$ for applications from 900 to 1400°C was initiated. Examination of nickel- and cobalt-base test capsules exposed to $^{244}Cm_2O_3$ at 750°C for 1000 and 10,000 h revealed that all materials were compatible under the test conditions. (auth)

30516 (ORNL-4870, pp 45-46) PHYSICAL METALLURGY OF HEAT-SOURCE CONTAINMENT MATERIALS. Donnelly, R. G. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Abstracts are given of publications on the effects of oxygen and interstitials on the mechanical properties of T-111 and TZM. Ir and Ir–2 at.% W or Re were exposed to low-pressure oxygen and/or graphite at 1300°C; mechanical property measurements show these materials to be compatible in these environments. (DLC)

30517 (ORNL-4870, pp 98-99) AUGER ELECTRON SPECTROSCOPY. Clausing, R. E. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

A facility for elemental analysis of surfaces was built especially for metallurgical studies. Apparatus for exposing grain boundaries, sputter thinning, producing atomically clean surfaces, cleaving crystals, residual gas analysis, and studying gas-metal reactions is included. Examples of many applied and basic studies are referenced in the text. (auth)

30518 SAFETY EVALUATION OF UNDERCLADDING CRACKS BY MEANS OF FRACTURE MECHANICS. Bartholome, G.; Dorner, H. (Siemens AG, Erlangen, Ger.). (1973). vp. (In German).

From third international congress on fracture; Munich, Germany (8 Apr 1973).

The safety evaluation of undercladding cracks shows that, based on test results obtained and the performed calculations, there is a sufficient safety margin against failure of the components. Evidence for this safety margin is given by the following examinations: (1). Experimental safety program: experimental safety program included mechanical testing of the several zones, observations of crack growth, fatigue tests, and brittle fracture tests; results are given. (2). Safety against undercritical crack growth: the growth of the undercladding cracks due to the specified cycles over the whole lifetime is negligible; calculations are described. (3). Safety against brittle fracture: this analysis is done with highly conservative assumptions; by means of linear elastic fracture mechanics it can be shown that there exists a sufficient safety margin against brittle fracture; calculations and results are given in detail. This allows the conclusion that undercladding cracks have no effects on operation and safety of nuclear power plants. (GE)

30519 CONTACT INTERACTION OF REFRACTORY COMPOUNDS WITH LIQUID METALS. IV. Interaction of Refractory Compounds With Liquid Metals of the Iron Series. Samsonov, G. V.; Panasyuk, A. D.; Borovikova, M. S. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 6, 51-57 (Jun 1973). (In Russian).

The process of boron single-crystal wetting by metals of the iron family was studied. In the systems Me (VIII)–B, an active chemical interaction with boride formation takes place. Temper-

ature and time dependences of the wetting angle of diborides of the IVa–VIa subgroups of the periodic system with metals of iron family were also studied. The character of interaction in these systems is shown to be different and determined by electronic structure both of borides and wetting material. (auth)

30520 COMPATIBILITY OF COPPER–TELLURIDE MELT WITH MOLYBDENUM. Natanzon, Ya. V.; Petrishchev, V. Ya. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 6, 48-50(Jun 1973). (In Russian).

Methods are developed for studying refractory metals interaction with melts of inorganic semiconductors. The compatibility of molybdenum with copper telluride melt is studied at 1200 and 1700°C and contact periods up to 24 h. No essential interaction was found under these conditions. (auth)

30521 MIGRATION OF OXYGEN DURING THE ANODIC OXIDATION OF TANTALUM. Pringle, J. P. S. (Chalk River Nuclear Labs., Ont.). J. Electrochem. Soc.; 120: No. 10, 1391-1400 (Oct 1973).

Oxygen-18 concentration profiles in thin oxide films were measured by combining a sectioning technique for locating the isotope with a nuclear method for detecting it. The system studied was the anodic oxidation of tantalum, and the oxide was sectioned by slow dissolution in concentrated HF almost saturated with NH_4F; the ^{18}O present was detected by bombarding the oxide with 3.042 MeV protons and counting neutrons emitted in $^{18}O(p,n)^{18}F$ reaction. On anodizing first in ^{16}O electrolyte and then in ^{18}O electrolyte, the ^{18}O incorporated last was found outside the ^{16}O layer incorporated first. There was, however, a small mixing of the populations at the boundary between them, and the degree of mixing was found to be proportional to the square root of the thickness added in the ^{18}O electrolyte. The results could be analyzed very well in terms of forced diffusion (under the influence of the electric field during anodization) from a constant source (the electrolyte) into a semi-infinite medium (the oxide), thus confirming that oxygen indeed migrates during the anodic oxidation of tantalum. (auth)

30522 TRANSIENT RESPONSE OF THE SYSTEM Ta/Ta_2O_5/ELECTROLYTE. II. Investigation of Faradaic Current-Driven Polarization Processes. Taylor, D. F.; Dignam, M. J. (Univ. of Toronto). J. Electrochem. Soc.; 120: No. 10, 1306-1310(Oct 1973).

Voltage pulse experiments were carried out on the system $Ta/Ta_2O_5/0.2N\ H_2SO_4$ to test for the presence of polarization processes which are driven toward their equilibrium (or steady-state) values by the passage of faradaic current. Such processes were observed, their behavior being in quantitative accord with that predicted by the dielectric relaxation model using the system constants determined from measurements of ion current transients. In addition, an "anomalous" effect was observed which appears to be related to an anomalous ac conductance effect, but is otherwise unexplained. It is believed that these experiments constitute a crucial test of this model, and one that it has passed. (auth)

30523 TRANSIENT RESPONSE OF THE SYSTEM Ta/Ta_2O_5/ELECTROLYTE. I. Ion Current Transients. Taylor, D. F.; Dignam, M. J. (Univ. of Toronto). J. Electrochem. Soc.; 120: No. 10, 1299-1305(Oct 1973).

The dielectric relaxation model for ion current transients is tested against both new data obtained under potentiostatic conditions and data obtained under galvanostatic conditions. A single set of system constants reproduces both sets of data. As has been already shown for the system Al/Al_2O_3/electrolyte, some of the system constants appear to vary slightly with film formation conditions, a possible consequence of minor structural or compositional changes. The results of ac impedance measurements made during steady-state film growth were also reproduced by the same set of system constants for frequencies below 1 kHz. Above 1 kHz, an anomalous increase in ac conductance with increasing frequency was observed. (auth)

30524 REFRACTORY METAL ALLOYS FOR USE IN OXIDATION ENVIRONMENTS. Anderson, W. T. Jr.; Mendelson, R. A. (to TRW Inc.). US Patent 3,753,701. 21 Aug 1973. Filed date 30 Dec 1971. 2p.

A refractory metal alloy comprising principally niobium and titanium, with lesser amounts of beryllium, chromium, silicon, and yttrium provides excellent resistance to air oxidation at high temperature. The broad composition range is as follows: Nb 32.5 to 46%; Ti 50.5 to 57.5%; Be 0 to 8%; Cr 2.15 to 2.6%; Si 0 to 8%; and Y 0 to 0.1%; all parts by weight. (Official Gazette)

30525 ELECTRON-STIMULATED DESORPTION OF CARBON MONOXIDE FROM A (111) NIOBIUM SURFACE. Davis, P. R.; Donaldson, E. E.; Sandstrom, D. R. (Washington State Univ., Pullman). Surface Sci.; 34: No. 2, 177-186(Jan 1973).

Electron-stimulated desorption of CO from the (111) face of a Nb single crystal produced both CO^+ and O^+ ions after adsorption at 150°K on a clean surface. When the surface was heated to above 250°K, only O^+ ions were observed, and this current disappeared as the temperature was increased to 700°K. Readsorption (at 150°K) was inhibited following the 700°K heating. These data indicate the formation on heating of a tightly bound surface phase with very low ionic desorption cross section. Threshold energies for CO^+ and O^+ ion production were 10.0 ± 0.5 and 19.0 ± 0.5 eV, respectively. The cross section for electron-stimulated depopulation of the O^+-producing phase was $(4 \pm 1) \times 10^{-18}$ cm^2 for 100-eV electrons. (6 figures, 16 references) (auth)

30526 INVESTIGATION OF ELECTRON INTERACTION IN ADSORPTION BY STATIC SKIN EFFECT METHOD. Panchenko, O. A.; Lutsishin, P. P.; Ptushinskii, Yu. G.; Shishkov, V. V. (Inst. of Physics, Kiev). Surface Sci.; 34: No. 2, 187-192(Jan 1973).

The reflection of the conduction electrons from surfaces of a thin ($d = 100\ \mu m$) monocrystalline plate of tungsten [(110) face] is investigated by the method of static skin effect. It is found that by heating the crystal in vacuum up to 2500°K, the oxide layer is removed and the specular reflection of the conductive electrons increases. The adsorption of the monomolecular layers of barium and copper atoms markedly increases diffuse reflection. A resonance mechanism of carrier interaction in the metal with adsorbed atoms is discussed. (auth)

30527 WORK FUNCTION MEASUREMENTS BY THE FIELD-EMISSION RETARDING-POTENTIAL METHOD. Strayer, R. W.; Mackie, W.; Swanson, L. W. (Linfield Research Inst., McMinnville, OR). Surface Sci.; 34: No. 2, 225-248(Jan 1973).

Using the field-emission retarding-potential method, true work functions were measured for the following monocrystalline substrates: W(100), W(110), W(111), W(100), Nb(100), Ni(100), Cu(100), Ir(110), and Ir(111). The electron elastic and inelastic reflection coefficients from several of these surfaces were also examined near zero primary beam energy. (16 figures, 29 references) (auth)

30528 DESORPTION KINETICS OF ALKALINE EARTH AD-PARTICLES ON TUNGSTEN WITH VARIATION OF THE OXYGEN SURFACE COVERAGE. Mueller, R.; Wassmuth, H. W. (Univ., Marburg, Ger.). Surface Sci.; 34: No. 2, 249-267(Jan 1973).

Utilizing the phenomenon of surface ionization, the mean residence time τ of alkaline earth ad-particles on a polycrystalline tungsten surface was investigated as functions of oxygen surface coverage and temperature with a pulsed beam method. From the temperature dependence of τ, the values of the desorption energy E_{M^0} of alkaline earth atoms and the corresponding pre-exponential factor $1/P^0_{M^0}$ were determined at different values of oxygen coverage. In the special case of a clean tungsten surface, the values of E_{M^0} obtained for Ca, Sr, and Ba were 3.3, 3.7, and 4.1 eV, respectively; the corresponding values of $1/P^0_{M^0}$ were 4×10^{-12}, 5×10^{-13}, and 8×10^{-13} s. A substantial increase of E_{M^0} with increasing oxygen surface coverage was observed for all alkaline earth elements, whereas the logarithm of $1/P^0_{M^0}$ decreased simultaneously resulting in a linear dependency between E_{M^0} and $\log (1/P^0_{M^0})$ ("linear logarithmic compensation effect"). (13 figures, 24 references) (auth)

30529 LITHIUM ADSORPTION ON THE (112) FACE OF TUNGSTEN. Medvedev, V. K.; Naumovets, A. G.; Smereka, T. P. (Inst. of Physics, Kiev). Surface Sci.; 34: No. 2, 368-384(Jan 1973).

Lithium adsorption on the (112) surface of tungsten single crystals was studied by contact potential difference measurement and low-energy electron diffraction. Dependences of the work function, adsorption heat, and atomic structures of lithium films on the lithium surface concentration are obtained. A close correlation is found between the changes in the film structure occurring with coverage and features of the work function and adsorption heat concentration dependences. It is concluded that interaction between lithium adatoms on W(112) is highly anisotropic. Order–disorder transitions in adsorbed lithium films are studied. 7 figures, 23 references. (auth)

30530 AUGER AND IONIZATION LOSS SPECTRA FROM Be SURFACES. Zehner, D. M.; Barbulesco, N.; Jenkins, L. H. (Oak Ridge National Lab., TN). Surface Sci.; 34: No. 2, 385-393(Jan 1973).

Auger and ionization loss spectra were obtained from clean and Si-contaminated Be surfaces both before and after oxidation. The Auger spectrum from the clean Be surface exhibits only one major minimum at 105 eV in the $dN(E)/dE$ versus E spectrum.

Si-contaminated Be surfaces produced corresponding spectra with two major minima at 92 and 105 eV. Partial oxidation of clean Be surfaces resulted in Auger spectra which resemble in kind those obtained from Be–Si surfaces. Following extensive oxidation, Auger spectra from both types of surfaces were indistinguishable, and Si L_{23} level ionization losses could no longer be detected. (auth)

30531 QUALITY ASSURANCE FOR PROTECTIVE COATINGS APPLIED TO NUCLEAR FACILITIES. New York; American National Standards Institute, Inc. (1973). 23p. (ANSI-N101.4-1972).

A common basis for the quality assurance of protective coatings applied to nuclear facilities is provided in the standard given. Quality assurance, as covered by this standard, comprises all those planned and systematic actions necessary to provide specified documentation and adequate confidence that shop or field coating work for nuclear facilities will perform satisfactorily in service. Quality control comprises those quality-assurance actions related to the physical characteristics of the entire coating work as a means of providing compliance with specified requirements. The scope includes the application and use of this standard; general requirements; coating materials; surface preparation of substrates; application of coating systems; coating inspection; and quality-assurance documentation. A glossary of terms is given. (MCW)

30532 DIFFUSION COATINGS PRODUCED BY ISOTHERMAL MASS TRANSFER IN LIQUID METALS. Ebozhnaya, O. M.; Shatinskii, V. F. (Physical-Mechanical Inst., Lvov). Fiz.-Khim. Mekh. Mater.; 9: No. 4, 43-48(1973). (In Russian).

It was found that by means of mass transfer in melts of lightly alloyed metals, used as transport intermediary media, diffusion coatings can be produced on samples of Armco-iron. The thickness and composition of the coating depend on the form of the transporter liquid metal and on the kinetics of the process controlling the saturation. Possible reactions between the basic component systems and the admixtures were examined. (tr-auth)

Preparation and Fabrication

30533 (ORNL-4870, pp 41-44) IRIDIUM FABRICATION. Donnelly, R. G. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Procedures were developed for melting and fabricating high-quality iridium and Ir–0.3% W alloy sheet for subsequent hydroforming at Mound Laboratory. Cleaning and sintering techniques were developed to lower the impurity content of starting powders and prepare them for electron-beam melting. The electron-beam drop-casting technique was used to produce 1-lb ingots routinely. Rolling studies determined that ingot breakdown temperatures of 1100 to 1200°C were required using molybdenum frames and cover plates. Warm rolling and intermediate stress-relief temperatures of pure iridium were very dependent on the trace impurity content. This sensitivity was overcome by alloying with 0.3% W. In a demonstration of production capability, 90 acceptable hydroforming blanks were produced in a 20-working-day period. An iridium purification process utilizing volatilization by high-temperature oxidation followed by reduction in hydrogen was demonstrated on a pilot scale. Materials containing up to 3% total impurities were upgraded to 99.98% Ir by this technique. The form of the input scrap produced a 15-fold difference in oxidation rate. Approximately 7 kg of impure iridium has been processed. (auth)

30534 (TID-26453) MICROCHEMICAL PREPARATIONS OF METALLIC CURIUM-248 AND CALIFORNIUM-249 BY THE REDUCTION OF THEIR TRIFLUORIDES, AND RELATED STRUCTURAL STUDIES. Stevenson, J. N. (Oak Ridge National Lab., Tenn.). Aug 1973. 106p. Dep. NTIS $7.50.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

Samples of the trifluorides of californium-249, curium-244 and -248 were prepared. The high-temperature, trigonal modification of CfF_3 was prepared by quenching methods and the phase transitions were studied. The average, room-temperature lattice parameters determined for the trigonal structure are: $a_0 = 6.945(3)$ Å; $c_0 = 7.101(2)$ Å. Previously unreported values for orthorhombic CfF_3 were averaged with reported values to obtain room-temperature lattice parameters of: $a_0 = 6.653(3)$ Å; $b_0 = 7.039(1)$ Å; $c_0 = 4.393(2)$ Å. The transition temperature was estimated to be between 550 and 700°C. The average, room-temperature lattice parameters for $^{248}CmF_3$ are: $a_0 = 7.014(3)$ Å; $c_0 = 7.194(3)$ Å; and for $^{244}CmF_3$, they are: $a_0 = 7.019(18)$ Å; $c_0 = 7.198(20)$ Å. The average parameters determined from the radiation-damaged $^{244}CmF_3$ samples were not significantly different from those of $^{248}CmF_3$. The accuracy of the lattice parameters determined for $^{244}CmF_3$ do not justify a definitive statement on the presence or absence of radiation-induced expansion of the $^{244}CmF_3$ lattice. Experimental apparatus and methods were developed for the microchemical preparations of metallic curium-248, berkelium-249, and californium-249 by the reduction of their trifluorides at elevated temperatures. The same apparatus and methods were used to prepare metal samples ranging in size from less than 10 to 500 μg and with volatilities covering several orders of magnitude. Curium-248 metal was found to exhibit the fcc and dhcp phases analogous to those of curium-244 metal. Average, room-temperature lattice parameters for the dhcp phase of curium-248 metal are: $a_0 = 3.500(3)$ Å; $c_0 = 11.34(1)$ Å; and for the fcc phase: $a_0 = 5.070(8)$ Å. For the first time the complete reversibility of the transformation between the phases has been demonstrated, thus supporting the conclusion that the fcc phase is a true, high-temperature form of curium metal. Californium-249 metal was found to exhibit an fcc structure with an average, room-temperature lattice parameter $a_0 = 4.994(12)$ Å. The possibility of the existence of other phases was indicated by the presence of additional lines in one pattern. The nitrides of curium-248 and berkelium-249 were prepared by reaction of the metals and/or their hydrides with nitrogen. Curium-248 nitride was found to exhibit an fcc structure with an average, room-temperature lattice parameter $a_0 = 5.027(12)$ Å. One sample of berkelium nitride yielded the fcc parameter $a_0 = 5.010(4)$ Å. (auth)

30535 DEVELOPMENT OF CORROSION-RESISTANT FILLER METALS FOR BRAZING MOLYBDENUM. Cole, N. C. (Oak Ridge National Lab., TN); Gunkel, R. W.; Koger, J. W. Weld. J. (N. Y.); 52: No. 10, 466-s-473-s(Oct 1973).

From 2nd international brazing conference; San Francisco, California (26 Apr 1973).

We have developed under extremely stringent criteria a series of Fe–Mo–C–B and Fe–Mo–Ge–C–B iron-base brazing filler metals for joining molybdenum. The method used to develop these alloys can be adapted for many other requirements, and the filler metals may also have applications other than the ones described. Presented here is the development of the filler metals from conception (to meet a certain need) through testing (to prove that they meet the need) to use in fabricating one of the most complex structures ever constructed of molybdenum. The filler metals exhibited excellent flowability below 2190°F. They brazed molybdenum to itself, to austenitic stainless steels, to nickel, and to carbon steels. Molybdenum-to-molybdenum brazes possessed excellent shear strengths at room temperature (>30,000 psi) with accompanying elongations exceeding 10%. At 1200°F the strengths were 18,000 to 29,000 psi with elongations exceeding 42%. These alloys showed outstanding corrosion resistance when exposed to liquid sodium and molten fluoride salts at 1110 to 1290°F. In addition, the Fe–Mo–Ge–C–B and Fe–Mo–C–B brazing filler metals had satisfactory corrosion resistance when exposed to static or flowing liquid bismuth at 1110 to 1290°F. The overall performance of the Fe–15% Mo–5% Ge–4% C–1% B filler metal appeared to be the best, and this alloy was used in fabricating a large molybdenum test stand. (auth)

30536 SOME PECULIARITIES OF SAMARIUM OXIDE PLASMIC SPRAYING. Arabei, B. G.; Loskutov, V. S.; Melimevker, O. D.; Mel'nikov, E. V.; Saksel'tsev, V. G.; Smirnov, Yu. V. Porosh. Met., Akad. Nauk Ukr. SSR; No. 6, 87-90(Jun 1973). (In Russian).

The possibility of samarium oxide plasma spraying is considered. The coefficient of powder utilization, burning coefficient, and density of the sprayed layer are investigated depending on nitrogen content in mixture of generator gas Ar + N_2, on power, supplied to the sprayer, and granularity of the spraying material. Practical possibility of samarium oxide spraying is established. The conditions for plasma spraying are recommended to ensure maximum coefficient of material utilization. (auth)

30537 PRODUCTION, QUALITY CONTROL, AND APPLICATIONS OF PURE RE MATERIALS AND ALLOYS. Gschneider, K. A. Jr. (Ames Lab., IA). pp 351-358 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

The light lanthanide metals are usually prepared by the metallothermic reduction method using Ca or Li, or by the electrolytic method. Yttrium and the heavy lanthanides are prepared only by the Ca or Li reduction method. The volatile lanthanides, Sm, Eu, Tm, and Yb are prepared by the La reduction of the oxide. Mischmetal, primarily because of economic reasons, is prepared electrolytically. The quality control with respect to the production of high-purity rare earth metals is discussed. The important metallurgical uses of the rare earths are examined, and the reasons for the utilization are noted. (auth)

30538 ALUMINOTHERMIC PRODUCTION OF FERROALLOYS. Belitskus, D. J. Metals; 25: No. 5, 39-44(May 1973).

Results of research on the effects of Al particle size and quantity and CaO flux quantity on bench-scale aluminothermic production of ferromolybdenum, ferroniobium and ferrotungsten are presented. Yields were invariably a function of aluminum-powder particle size which caused differences in metal–slag separation or completeness of reaction. Optimum powders were medium in fineness (No. 120) or coarse (No. 129), while yields were lowest with a very fine (No. 140) or very coarse (No. 130) powder. (JRD)

30539 INFLUENCE OF PRESSURE ON DEPOSITION CHARACTERISTICS OF CVD TUNGSTEN. Schroff, A. M. (Thomson-CSF, Orsay, France). pp 69-94 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

W and Mo deposits were realized on various substrates such as copper, stainless steel and molybdenum. The deposition temperature was varied from 450 to 1300°C in the case of tungsten and from 600 to 1300°C for molybdenum. The reaction was carried at partial pressures of 10^{-2} to 760 torr and the ratio of hydrogen to halide was varied from 1 to 6. The following data were obtained: variation of the deposition thickness versus pressure for various temperature and different H_2/halide ratios; crystal structure; crystal orientation; number of defects; gaseous impurities; and influence on the deposition rate of gases such as argon or helium. A crystallographic working model is presented in order to explain the various crystal growth. At pressures from 760 to 1 torr, two mechanisms occur, one at low temperature which is mainly surface reduction and the other one at high temperature which is nucleation in the vapor phase. At low pressure below 1 torr, the mean free path of the molecule and its speed have to be taken into account and the reaction can be mainly classified as the surface-reaction type. (13 figures, 4 tables, 13 references) (auth)

30540 GEOMETRIC CONSIDERATIONS IN CHEMICAL VAPOR DEPOSITIONS. Chin, J. (Gulf General Atomic Co., San Diego, CA). pp 164-175 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Temperature and gas composition have a pronounced effect on the microstructure of tungsten deposited by hydrogen reduction of tungsten hexafluoride. Deposition of tungsten on bodies of different shapes under the same conditions can produce tungsten with a varied microstructure. The reason for this variable microstructure is thought to be localized thermal gradients and localized depletion of WF_6 in the feed gas. A description is given of some experimental work which supports this argument. Microstructure variations caused by localized heating and gas depletion are examined in terms of chemical vapor deposition theory. (9 figures) (auth)

30541 PREPARATION AND PROPERTIES OF THORIATED CHROMIUM. Veigel, N. D.; Blocher, J. M. Jr.; Browning, M. F. (Battelle Memorial Inst., Columbus, OH). pp 200-213 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaske, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Apparatus and procedure are described for the preparation of thoriated chromium powder by hydrogen reduction of chromous iodide vapor in a "flame" reactor. With a tangential nozzle design, up to 250 g of powder could be prepared in a continuous run before constriction of the nozzle by deposited chromium forced termination. Several preparations containing about 3 vol% ThO_2 were consolidated by hot isostatic pressing, rolled to sheet, and evaluated in sheet form. The addition of ThO_2 lowered the ductile-to-brittle transition temperature, e.g., from 140°C to 15°C in the as-rolled condition and from 140°C to 50°C in the annealed condition. The dispersion was stable over 100 h at 1427°C. (11 figures) (auth)

30542 PREPARATION AND EVALUATION OF CHEMICALLY VAPOR DEPOSITED RHENIUM THERMIONIC EMITTERS. Yang, L.; Hudson, R. G.; Ward, J. J. (Gulf General Atomic, Inc., San Diego, CA). pp 253-269 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Rhenium thermionic emitters were prepared by the pyrolysis of rhenium chlorides formed by the chlorination of rhenium pellets. The impurity contents, microstructures, degrees of (0001) preferred crystal orientation, and vacuum electron work functions of these emitters were determined as a function of deposition parameters, such as substrate temperature, rhenium pellet temperature and chlorine flow rate. A correlation between vacuum electron work function and degree of (0001) preferred crystal orientation was established. Conditions for depositing porosity-free rhenium emitters of high vacuum electron work functions were defined. (5 figures, 6 tables) (auth)

30543 SELECTIVE-CHEMICAL VAPOR DEPOSITION OF TUNGSTEN. Cuomo, J. J. (Thomas J. Watson Research Center, Yorktown Heights, New York). pp 271-291 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Depositions; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Tungsten is shown to deposit selectively by the hydrogen reductions of tungsten hexaflouride. The process is termed Selective-Chemical Vapor Deposition of tungsten since tungsten is deposited only on prepatterned areas of a substrate. The selective process occurs when two surfaces with different chemical reactivities are exposed to the CVD environment. One surface acts as a tungsten nucleation site while the other chemically erodes (ablates) and tungsten metal does not nucleate. Many potential applications are envisioned for the Selective Deposition process both with the use of tungsten and other systems. (16 figures, 3 tables) (auth)

30544 DEVELOPMENT OF A CONTINUOUS CVD PROCESS FOR PRODUCING FABRICATED WIRES. I. Process Analysis. Brecher, L. E. (Westinghouse Electric Corp., Pittsburgh). pp 292-312 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

The production rate of a continuous CVD process for wire is dependent upon the deposition reactor design, the plant operational policy with regard to broken wires, and the inherent process inefficiencies—the reactor rethreading time and the fabrication break frequency. A mathematical analysis of this CVD process reveals that the primary requirement for an economical process is a low fabrication-break frequency, while rethreading time is not of major importance unless highly efficient operation is desired. These constraints can be relaxed further, if necessary, by variations in reactor design and by partial recovery of wires broken during fabrication. Quantitative comparisons between these approaches are illustrated, and guidelines for the experimental program are established. (7 figures) (auth)

30545 DEVELOPMENT OF A CONTINUOUS CVD PROCESS FOR PRODUCING FABRICATED WIRES. II. Bench-Scale Demonstration. Brecher, L. E.; Archer, D. H. (Westinghouse Electric Corp., Pittsburgh). pp 313-324 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

The bench scale operation of a continuous CVD process for producing fabricated wire has established the following features of the process: (a) Tungsten wire can be produced directly at 25 mil diameter by a process which involves the simultaneous steps of cleaning, deposition, and drawing of a continuously moving wire. (b) Commercially practical deposition rates, 60 to 120 mils/h, can be achieved. (c) Fabrication reliabilities sufficient to warrant a commercial process can be obtained. Details of the experimental program are presented including the deposition reactor design and system configuration, microstructures of product wire produced directly at 25 mil diameter and containing more than 70% CVD tungsten, and fabrication reliabilities possible with this system. (auth)

30546 CHEMICAL VAPOR DEPOSITION OF TUNGSTEN AND MOLYBDENUM: REDUCTION OF FLUORIDES AT HIGH TEMPERATURE AND LOW PRESSURE. Faron, R. (Societe des Usines Chimiques, Pierrelatte, France); Barques, M.; Gillardeau, J.; Hasson, R.; Dejachy, G.; Durand, J. P. pp 439-452 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

An epitaxial growth of Mo, W, and Mo–W alloys obtained by reduction of the fluorides MoF_6 and WF_6 with hydrogen at low pressure (1×10^{-4} to 1 mm Hg), high temperature (1200 to 2000°C) and various H_2/MF_6 ratios (1 to 30) is described. Special growth with disjointed epitaxial nuclei or with compact grains giving rise to

dense planes are studied on monocrystals and polycrystals. Metallographic, scanning-microscope, Castaing-microprobe, and radiocrystallographic examinations were carried out. The technology employed is discussed. (16 figures, 13 references) (auth)

30547 CHEMICAL-VAPOR-DEPOSITED TUNGSTEN AS A MEANS TO REDUCE HIGH-TEMPERATURE EROSION IN GUN BARREL BORES. Meyer, K. H. (Electronic Vision Corp., San Diego, CA). pp 625-642 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

One of the most erosive environments for a material can be found in the bore of a gun barrel during propellant combustion. Conditions of high temperature, high pressure, and chemical reactions with ionized hydrogen, nitrogen and carbon result in crack formation and materials removal, leading to blow-by, loss of muzzle velocity, and accuracy. To reduce erosion effects, small-caliber gun barrels were plated with tungsten, using the chemical vapor deposition process. As the result, a reduction of erosion by several orders of magnitude was obtained in tungsten-plated gun barrels under high-rate-of-fire conditions in comparison to unplated gun barrels fired under the same conditions. Details of the tungsten plating process and the results are described. (7 figures) (auth)

30548 STUDIES OF SUBSTRATE EFFECTS ON THE CHEMICAL VAPOR DEPOSITION OF TUNGSTEN. Shim, H. S.; Haskell, R. W.; Byrne, J. G. (Univ. of Utah, Salt Lake City). pp 715-727 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From Third International Conference on Chemical Vapor Deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

X-ray pole figure, transmission electron microscopy, scanning electron and optical microscopy, and mechanical testing were used to study the effects of varying the substrate temperature on the properties of chemical-vapor-deposited tungsten. In particular, the studies showed that tungsten deposited on a 500°C substrate was 3000 psi stronger than that deposited on a 700°C substrate for test temperatures ranging from 200°C to 1000°C. Also it was found that fluorine content decreases with increasing temperature and preferred orientation increases with increasing temperature. (6 figures, 3 tables, 14 references) (auth)

30549 MOESSBAUER-EFFECT STUDY OF COLLECTIONS OF COBALT IN GRAIN BOUNDARIES OF BERYLLIUM. Martin, G. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Status Solidi (a); 18: No. 2, 683-687 (16 Aug 1973). (In French)

Moessbauer spectra emitted from ^{57}Fe nuclei diffused along grain boundaries in beryllium are typical of a Co-rich environment. These Co-rich islands exhibit a superparamagnetic behavior. (auth)

30550 ANALYSIS OF SPUTTERING DISCHARGE BY OPTICAL AND MASS SPECTROMETRY. I. PLATINUM AND TANTALUM SPUTTERED IN ARGON. Westwood, W.D.; Boynton, R.J. (Bell-Northern Research, P. O. Box 3511, Station C, Ottawa, Canada). J. Appl. Phys. 44: No. 6, 2610-2618 (June 1973).

Optical emission and mass spectrometry techniques have been used to investigate the gas composition during the sputtering of platinum and tantalum in an argon discharge in a dc diode system. The optical emission technique shows that hydrogen is always present in the discharge although the mass spectrometer only detects hydrogen in the case of tantalum. For both metals, the hydrogen is due to dissociation of water vapor, either in the discharge or in the tantalum case by reaction with the tantalum, and its concentration depends on the sputtering conditions and duration and also on the sputtering and vacuum procedures used. The deposition rates of both metals increase as the hydrogen concentration decreases because a greater percentage of the discharge current is due to argon instead of hydrogen ions; changes of 20% in the deposition rate are observed due to this effect. The resistivity of the tantalum films increases with the hydrogen concentration in the discharge, if the hydrogen is due to dissociation of water vapor; no increase is observed when hydrogen is leaked into the sputtering system to increase the hydrogen concentration. It is proposed that the increase in resistivity is due to an increase in the oxygen concentration in the tantalum films, water vapor produced by outgassing being the source of oxygen. At 4.0 kV, changes in resistivity from 210 to 257 $\mu\Omega$ cm were observed and, at 3.0 kV, the resistivity changed from 382 to 560 $\mu\Omega$ cm. The optical emission technique shows promise as a tool for investigating processes taking place in a sputtering discharge without disturbing the system. (auth)

30551 ANALYSIS OF SPUTTERING DISCHARGE BY OPTICAL AND MASS SPECTROMETRY. II PLATINUM AND TANTALUM SPUTTERED IN ARGON/NITROGEN MIXTURES. Westwood, W.D. (Bell-Northern Research, P. O. Box 3511, Station C, Ottawa, Canada). J. Appl. Phys. 44: No. 6, 2619-2626 (June 1973).

The gas composition during sputtering of tantalum and platinum in argon–nitrogen mixtures in a dc diode system has been investigated using optical and mass spectrometry. Both methods show that, for sputtering tantalum, the water-vapor pressure is significantly reduced by the addition of nitrogen, although no nitrogen is observed until a flow rate of 0.3 $cm^3\ min^{-1}$ is reached. For platinum, however, nitrogen is observed at much lower flow rates and no reduction in the water vapor takes place. After sputtering tantalum in the presence of nitrogen, ammonia is the main residual gas and it is suggested that the reactions required to form it take place at a tantalum surface. For nitrogen flow rates less than 0.3 $cm^3\ min^{-1}$, the β–Ta phase is replaced by the bcc phase with a consequent reduction in film resistivity. The nitrogen apparently prevents the incorporation of oxygen in the film, but some nitrogen is probably dissolved in the bcc phase. At flow rates just above 0.3 $cm^3\ min^{-1}$, the Ta_2N phase is formed and is replaced by the TaN phase at higher flow rates. The increase in resistivity with increasing flow is probably due to the presence of an insulating amorphous nitride phase. The tantalum deposition rate decreases with increasing nitrogen flow because of the reduction in the hydrogen concentration, the replacement of argon by nitrogen as the sputtering species, and, possibly, the formation of nitrides on the cathode. The ratio of the intensity emitted by excited tantalum atoms to the tantalum deposition rate increases rapidly with nitrogen flow and this may be due to the formation of nitrides on the cathode. The film density also decreases from 14.0 to 6.5 $g\ cm^{-3}$ as the nitrogen flow rate is increased. (auth)

30552 MICROSTRUCTURE, GROWTH, RESISTIVITY, AND STRESSES IN THIN TUNGSTEN FILMS DEPOSITED BY RF SPUTTERING. Petroff, P.; Sheng, T.T.; Sinha, A.K.; Rozgonyi, G.A.; Alexander, F.B. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Appl. Phys. 44: No. 6, 2545-2554 (June 1973).

The growth process and the microstructure of very thin W films (80–500 Å) deposited by rf sputtering on SiO_2 and Si substrates have been observed by transmission electron microscopy (TEM). The resistivity and stress in these films have been related to the film microstructure, composition, and to the deposition conditions (substrate bias and rf deposition power). Thin W films deposited on silicon dioxide substrates under zero or positive bias have been found to grow in two distinct growth stages. Stage I corresponds to the formation of a thin continuous film (80–100 Å thick) of β–W. The β–W phase has the A–15 crystal structure and has been identified as a faulted W_3W compound. A small grain size (50–100 Å) is characteristic of the β–W film. Stage II corresponds to the transformation of the β–W film into a pure α–W film with the bcc crystal structure. This thermally activated phase transformation takes place in the temperature range 100–200 °C. It is characterized by the growth of α–W nuclei until complete coalescence of the α–W islands; the resulting α–W film consists of large grains (1500–2500 Å) which are free of dislocations. The end of stage II occurs for a critical film thickness t_c beyond which the film is a continuous $\alpha-W$ film. The value of t_c is controlled by the rf deposition power and the substrate temperature. On the other hand, films deposited on negatively biased substrates do not contain the $\beta-W$ phase. These films consist of large $\alpha-W$ grains (1500–2000 Å) with a high dislocation density. The resistivity of thin W films deposited under zero or positive bias is controlled by the amount of $\beta-W$ present in the film. The pure $\beta-W$ films have a high resistivity (100–300 $\mu\Omega$ cm); after the complete transformation $\beta-W \rightarrow \alpha-W$ the large resistivity (30–40 $\mu\Omega$ cm) of these films is attributed to scattering by impurities. In particular, the lower resistivity of W films deposited under negative bias is related to their lower oxygen content. The sign and magnitude of the stress in these films are also controlled by the film microstructure. It is found that the stress in the films containing the $\beta-W$ phase is always tensile with a σ of $(6-12) \times 10^9$ dyn/cm². The films consisting of $\alpha-W$ are always compressively stressed in the range $(2-12) \times 10^9$ dyn/cm². (auth)

30553 SINGLE SOURCE EVAPORATION OF A NIOBIUM BASED ALLOY CONTAINING VOLATILE CONSTITUENTS. Stowell, W.R. (Coatings Application Division, Battelee Columbus Laboratories, 505 King Ave., Columbus, Ohio 43201). J. Vac. Sci. Technol. 10: No. 4, 489-493 (July 1973).

By adding excess niobium to the molten metal pool of a rod–fed evaporation source in order to approximate a steady state condition, reproducible transfer of source material containing niobium, titanium, chromium, and aluminum has been achieved. Single source evaporative coating of this material has not been considered practical prior to this work because of the factor of 10^6 difference in vapor pressure between the most volatile element and the least volatile element. As produced, the coatings had a banded structure. A heat treatment homogenized the coatings. A model is suggested to explain the banded structure. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 31268, 31513, 31514, and 32202.

30554 (CEA-R-4474) STUDY OF URANIUM ALLOYS CONTAINING SMALL QUANTITIES OF VANADIUM. Reisse, R. (Commissariat a l'Energie Atomique, Bruyeres-Le-Chatel (France). Centre d'Etudes). Aug 1973. 107p. (In French). Dep. NTIS (U.S. Sales Only) $7.50.

Thesis. Submitted to Univ., Lyon.

It is possible to obtain fine α-grain uranium alloy in the newly cast state by adding small quantities of vanadium. The alloy must contain at least 0.2% vanadium and have a low carbon content or at least 0.3% vanadium and have a slightly higher carbon content. Carbon is the principal impurity of these alloys. In the solid phase it reacts with vanadium to form complex carbides. The 0.2% alloy having a low carbon content possesses the most desirable properties: good refining characteristics over a large cooling rate range (4 to 70°C/minute); remarkably good mechanical characteristics for this type of alloy (notably ductility) at room temperature and in the α region (except near 500°C). The hardened structures are not fragile and are easily welded. (auth)

30555 (CEA-R-4481) CONTRIBUTION TO SELF-DIFFUSION AND HETERODIFFUSION STUDIES IN BODY-CENTERED CUBIC METALS. Languille, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Sep 1973. 197p. (In French). Dep. NTIS (U.S. Sales Only) $12.00.

Thesis. Submitted to Paris Univ., Orsay (France).

Self-diffusion in δ-cerium and γ-lanthanum were studied. The diffusivities are very high and activation energy is low: bcc δ-cerium $D = 8.5 \times 10^{-3} \exp(-20300/RT)$ cm^2/s, bcc γ-lanthanum $D = 0.11 \exp(-29900/RT)$ cm^2/s. Diffusivity increases under pressure in δ-cerium $(\Delta V/V_M = -0.10)^+$. The activated interstitial model by an electronic transfer $4f \rightarrow 5d$ is confirmed; it has been first applied to ϵ-plutonium. It looks as if diffusion anomalies observed would be connected with the f-character instability in rare earth and actinium series. Heterodiffusion experiments, in particular in cerium, confirm this assumption. (29 tables, 45 figures, 207 references) (auth)

30556 (CONF-710947-P1, pp 275-279) MOESSBAUER EFFECT IN FeV AND FeCr ALLOYS. Nemoshkalenko, V. V.; Razumov, O. N.; Nagornyi, V. Ya.; Tomashevskii, N. A. (Inst. of Metal Physics, Kiev). 1971. (In Russian).

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

By means of the methods of nuclear gamma resonance and x-ray spectroscopy, the electronic structures of FeV and FeCr alloys were studied in relation to the phase compositions. The kinetics of the $\alpha \rightarrow \sigma$ phase transformation of an Fe–45% Cr alloy was investigated. (tr-auth)

30557 (CONF-710947-P2, pp 377-380) INVESTIGATION OF CERIUM–IRON INTERMETALLIC COMPOUNDS WITH THE MOESSBAUER AND MAGNETIC METHODS. Bara, J. (Jagellonian Univ., Krakow); Bodak, O. I.; Krolas, K.; Matlak, T.; Ruebenbauer, K.; Suski, W. 1971.

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

Moessbauer and magnetic measurements were carried out for β-Ce_2Fe_{17} and hypothetical $CeFe_7$ compounds at different temperatures. A magnetic ordering point is found for β-Ce_2Fe_{17} at 209°K. The existence of the $CeFe_7$ compound is doubtful. (auth)

30558 (CONF-710947-P2, pp 681-695) MOESSBAUER-EFFECT STUDY OF SOME IRON–RARE-EARTH COMPOUNDS OF THE TYPE $Fe_{17}R_2$. Agarval, V. K.; Kuz'min, R. N.; Chechernikov, V. I. (Moscow Univ.). 1971. (In Russian).

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F.R. Germany (20 Sep 1971).

By means of the ^{57}Fe Moessbauer effect, intermetallic compounds of the type $Fe_{17}R_2$ (R = Pr, Nd, Gd, Dy, Er, and Y) were investigated from liquid-N_2 temperature to temperatures above the Curie points. Crystal structure and phase analysis results are discussed and compared with previous investigations that used magnetic and x-ray methods. (6 figures, 2 tables, 15 references) (LMT)

30559 (ORNL-4870, pp 4-6) DEFORMATION OF CRYSTALLINE SOLIDS. Williams, R. O. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Studies are being conducted of the structures of solid solutions, equilibria between solutions, and precipitation from such solutions. The fracture mechanism in precipitation-hardened bcc alloys is considered. (DLC)

30560 (ORNL-4870, pp 47-48) TUNGSTEN METALLURGY. Schaffhauser, A. C. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

The creep properties of CVD tungsten depend on the fluorine impurity content of the material. At 1650°C and stresses above 2000 psi, material with about 20 ppM F is significantly stronger than that with low fluorine in tests to 3000 h. In tests to 10,000 h at 1000 psi, low-fluorine material is stronger. The creep strength of tungsten in a carburizing atmosphere depends on the formation of a crack-free carbide layer. The physical properties of tungsten and tungsten–rhenium alloys irradiated at high temperature in a fast-neutron flux were partially evaluated. (auth)

30561 (ORNL-4870, pp 93-97) METALLOGRAPHY. Gray, R. J. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Magnetic etching is being used in the study of materials containing ferromagnetic and paramagnetic constituents in the microstructure. This report shows the application of this technique in the study of 16 Cr–8 Ni–2 Mo welds deposited by the weave method. Metallography and radiography, often used as a team to better show and understand materials, are combined to show the size and distribution of voids in welds. The standards for thermocouple wires must remain high. Metallographic examinations of stainless-steel-sheathed W–25% Re and W–3% Re thermocouple wires are examples of the importance of scanning electron microscopy and standard optical microscopy to show flaws. (auth)

30562 (ORNL-TM-4131) CREEP PROPERTIES OF A TYPE 308 STAINLESS STEEL PRESSURE VESSEL WELD WITH CONTROLLED RESIDUAL ELEMENTS. King, R. T.; Stiegler, J. O.; Goodwin, G. M. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 32p. Dep. NTIS $4.00.

A SMA-type 308 stainless steel pressure vessel test weld with the controlled residual elements (CRE) boron (0.007%), titanium (0.06%), and phosphorus (0.04%) was tested in creep between 482 and 650°C. Improved ductility compared with that of standard welds in tests lasting several thousands of hours is associated with the absence of interphase separation. Systematic variations of microstructure and creep properties through the weld and in the heat-affected zone are due to thermal and mechanical cycling during the welding process. Anisotropic deformation occurs and is related to local substructure and preferred crystallographic orientation. Creep strengths are acceptable by present design rules. (auth)

30563 (ORNL-TM-4351) FABRICATION AND MECHANICAL TEST DATA FOR ACCEPTANCE OF THE FIRST SIX 6-INCH-THICK INTERMEDIATE TEST VESSELS OF THE HEAVY SECTION STEEL TECHNOLOGY PROGRAM. Childress, C. E. (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 84p. Dep. NTIS $5.45.

The HSST program has among its goals the objective to demonstrate the capability to predict safe behavior of thick-walled pressure vessels, containing flaws of known dimensions under frangible, transitional, and tough loading regimes. Accordingly, the program is conducting a series of tests involving 6-in.-thick pressure vessels, which will serve as test specimens for assisting in the characterization of failure under these loading conditions. Among the vessels a number of parameters, such as weld type, weld location, flaw size and shape, and test temperature and pressure will be selectively varied to show that a rationale exists for dealing with the varied stress and metallurgical states which normally exist in commercial nuclear reactor vessels. Each vessel will serve as a go, no-go determination of critical flaw size for a specific set of test parameters. The manufacturing details of the individual components and their ultimate assembly into finished vessels are described. Data on chemical composition, mechanical and nondestructive testing are included. (auth)

30564 (RDT-M-2-18-T(7-73)) PRECIPITATION HARDENING NICKEL ALLOY BARS, FORGINGS, AND FORGING STOCK FOR HIGH-TEMPERATURE SERVICE (ASTM A 637 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Research and Development (AEC), Washington, D.C.). Jul 1973. 11p. RSO.

A standard prescribing requirements for precipitation hardening bars, forgings, and forging stock for high temperature service (ASTM A 637 with additional requirements) for nuclear and associated applications is presented. (JRD)

30565 (RDT-M-5-19-T(3-73)) AUSTENITIC STAINLESS STEEL PLATE, SHEET, AND STRIP FOR CORE COMPONENTS.

(Division of Reactor Research and Development (AEC), Washington, D.C.). Mar 1973. 18p. RSO.

A standard prescribing requirements for austenitic stainless plate, sheet, and strip for core components in nuclear and associated applications is presented. (JRD)

30566 (RDT-M-7-23-T(3-73)) AUSTENITIC STAINLESS STEEL BAR FOR CORE COMPONENTS. (Division of Reactor Research and Development (AEC), Washington, D.C.). Mar 1973. 20p. RSO.

A standard prescribing requirements for austenitic stainless steel bar for core components in nuclear and associated applications is presented. (JRD)

30567 (RDT-M-7-24-T(3-73)) AUSTENITIC STAINLESS STEEL WIRE FOR CORE COMPONENTS. (Division of Reactor Research and Development (AEC), Washington, D.C.). Mar 1973. 19p. RSO.

A standard prescribing requirements for austenitic stainless steel wire for core components in nuclear and associated applications is presented. (JRD)

30568 (SLL-73-40) DYNAMIC ELASTIC–PLASTIC RESPONSE OF ALUMINUM RINGS SUBJECTED TO A COSINUSOIDALLY DISTRIBUTED IMPULSE LOADING. Wesenberg, D. L.; Birnbaum, M. R. (Sandia Labs., Livermore, Calif.). Aug 1973. Contract AT(29-1)-789. 50p. Dep. NTIS $4.50.

A comprehensive analytical and experimental investigation is described on the dynamic elastic and plastic response of thin rings. Excellent correlation was obtained between experimental results and numerical predictions for the flyer/air cushion/target momentum transfer and for the structural ring response. This demonstrates a thorough understanding of the physical processes involved, both on a wave mechanics and a structures level. (auth)

30569 ELECTRICAL CONDUCTIVITY OF INTERMETALLIC COMPOUNDS OF THE CERIUM–THALLIUM SYSTEM. Cismaru, G. D.; Spacu, P. (Centre of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 18: No. 8, 1345-1351(Aug 1973).

The electric conductivity of intermetallic compounds of the Ce–Tl system was studied. An exponential increase of conductivity was observed on increasing the atomic fraction of Tl. The conductivity variation within the system confirmed the formation of Ce_5Tl_3, CeTl and $CeTl_3$ compounds and confirmed the existence of the Ce_2Tl compound. Values of N_{ef}^{5} l product for each compound of Drude's corrected equation were determined. (auth)

30570 RARE EARTH INTERMETALLICS. Wallace, W. E. Materials Science and Technology. New York; Academic Press, Inc. (1973). 277p. $22.50.

Research during the last decade on the magnetic behavior and low-temperature specific heats of rare earth intermetallic compounds is summarized. Information is included on magnetic interactions, crystal field interaction effects on thermal and magnetic behavior, and properties of rare earth intermetallic compounds with Al, Ga, In, Tl, Cu, Ag, Au, Si, Ge, Sn, Pb, Be, Mg, Zn, Cd, Hg, Ni, Co, Fe, Mn, and 4d and 5d transition metals. (JRD)

30571 VERY FAST QUENCHING OF NIOBIUM AND VANADIUM. Savitskii, E. M.; Revyakin, A. V.; Efimov, Yu. V.; Glyuzitskii, B. D.; Sumarokov, V. N. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 2, 405-407(11 May 1973). (In Russian).

A rapid rate of cooling Nb or V was attained by heating the metal in a magnetic field in helium, and after holding 20 to 30 s the current strength was sharply increased to superheat the metal and break off drops of metal which fell on a massive copper disk rotating with a velocity up to 5000 rpm. Metal films 0.1 to 0.2 mm thick were obtained. The cooling rate was calculated to be $\sim 6 \times 10^6$ (°C)/s. The samples were subjected to microstructural and x ray analyses. The microhardness and critical superconducting temperature T_c were also measured. No evidence could be found for a high-temperature modification of vanadium whose existence had been postulated above 1550°C. The data indicate that very fast quenching causes a sharp decrease in grain size of niobium and vanadium, and an increase in the number of lattice defects, in particular, in the dislocation density, which causes an increase in hardness and strength without any essential change in plasticity, since the quenched samples are readily rolled at room temperature. The effect of rapid quenching on the superconducting properties of Nb and V is small (a shift decrease in the critical superconducting temperature T_c), and is analogous to the effect of cold deformation. (SJR)

30572 MAGNETIC PROPERTIES OF CsCl-TYPE RARE EARTH–MAGNESIUM COMPOUNDS. Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Less Common Metals; 33: 239-244(1973).

The magnetic properties were determined in the temperature range 4.2 to 300°K with applied magnetic fields up to 18 kOe. There is a change in sign of the asymptotic Curie temperatures in going from compounds with light rare-earth elements to those with heavy rare-earth elements. The temperature dependence of the magnetization in the magnetically ordered region points to antiferromagnetism for the former compounds and to ferromagnetism for the latter compounds. For all compounds investigated, the lattice constants were determined. (auth)

30573 MAGNETIC ANISOTROPY OF SOME RARE EARTH–COBALT COMPOUNDS (R_2Co_7). Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Less Common Metals, 33: 311-312(1973).

Powders of R_2Co_7 (R = La, Pr, Nd, Sm, Gd, and Y) were aligned in a 45-kOe field and fixed with an epoxy resin. Measurements of the magnetization and its field dependence were made parallel and perpendicular to the alignment field; graphs are given for Pr_2Co_7 and Y_2Co_7. Anisotropy fields were estimated (lower limits) by extrapolation of the $\sigma_{||}$ and $\sigma_{\perp}$ curves. (DLC)

30574 DIMENSIONAL INSTABILITY OF URANIUM UNDER THERMAL CYCLING. Gentile, E. F. (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo); 28: No. 172, 203-209(Mar 1972). (In Portuguese).

A survey of the dimensional instability of uranium when subjected to thermal cycling was conducted. The variables that control those changes are reviewed, including those related to the production method utilized. The dimensional instability is characterized by an exaggerated lengthening of the test pieces under cycling and by a marked roughening of its surfaces. The work done with uranium bars to gather the basic information required for future work related to the fabrication of uranium metal fuel elements is described. (auth)

30575 FRACTURE TOUGHNESS OF BERYLLIUM. Cooper, R. E. (Atomic Weapons Research Establishment, Aldermaston, Eng.). (1973). vp.

From third international congress on fracture; Munich, Germany (8 Apr 1973).

The plane strain fracture toughness of fully dense beryllium lies in the range 8 to 16 kpsi. Compressive stresses due to notch machining can cause large errors in fracture-toughness measurements. A small amount of porosity has a beneficial effect on the fracture toughness and Charpy impact properties of beryllium. A model in which the pores are regarded as flaws provides a semiquantitative explanation of the effects. (GE)

30576 THERMAL EXPANSION OF THULIUM IN THE 2 TO 300°K TEMPERATURE RANGE. Petrenko, N. S.; Popov, V. P. (Kharkov State Univ.). Zh. Eksp. Teor. Fiz.; 65: No. 1, 249-251 (Jul 1973). (In Russian).

Thermal expansion of Tm (~99.9% purity) is investigated by the dilatometric technique at low temperatures. The anomalies in the thermal expansion observed at 56, 32, and 10°K can be ascribed to magnetic transformations at these temperatures. (auth)

30577 ASSESSMENT OF DEFECTS BY MEANS OF FRACTURE MECHANICS. Wellinger, K. (Staatliche Materialpruefungsanstalt, Stuttgart); Schock, W.; Kussmaul, K.; Kraegeloh, E. (1973). vp. (In German).

From 3rd international congress on fracture; Munich, Germany (8 Apr 1973).

In order to put fracture mechanics technology to good practical use for analyzing the fracture behavior of thick-walled large-scale components made from medium-strength steels (σ_U to 80 kp/mm^2), failures and full-scale tests are discussed. Examples are given which refer to the pressure vessels—their cylindrical length ranging from 5.3 to 10.5 m. Information is included on the good correlation between bursting dates and fracture toughness (ASTM 399-70 T) for the experimentally cycled vessels with cracks, and the low correlation between fracture toughness and full-scale behavior when cracks occurred during the manufacturing process or in service. This is due to embrittlement in the region of the crack front and microresidual stresses. The question is how far macroresidual stresses may be taken into account for welded full-scale structures. The current state of the art does not allow the utilization of fracture mechanics technology for components without cracks but does allow local multi-axial stress state embrittlement and phase embrittlement. (GE)

30578 DENSITY OF STATES AND SOME PHYSICAL PROPERTIES OF ALLOYS OF THE VANADIUM–CHROMIUM SYSTEM. Belousov, O. K.; Kornilov, I. I. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 2, 374-376(11 May 1973). (In Russian).

For alloys of elements of the third row, a significant maximum in the density of states is observed in the region of electron concentrations of 4 to 6 electrons/atom. Vanadium–chromium alloys

were prepared by levitation melting, and annealed at 600 to 800°C from 24 to 100 h. Measurements were made on the alloys for the atomic susceptibility χ by suspending the sample in a magnetic field, for the absolute thermo-emf, and for electrical resistance γ over the whole range of concentrations. Positive values of the absolute thermo-emf values increase from 0.1 μV/degree (vanadium) to 9.5 μV/degree (chromium) with a sharp minimum in the region of 4.7 to 5.4 electrons/atom. Apparently the region of 5.4 to 5.6 electrons/atom is connected with a slight increase of density of states in the d zone. At these electron concentrations, probably, the curie point reaches room temperature, at which the measurements were performed (it should be noted that vanadium also has a transition into an antiferromagnetic state below room temperature). Further alloying leads to an increase in positive values of the absolute thermo-emf up to pure chromium. The electrical resistance curve shows two inflection points at 5.4 and 5.7 electrons/atom, which also can be related to this transition. Above electron concentrations of 5.5 to 5.6 electrons/atom, the electrical resistance and hence, the density of states decrease more sharply and pass through a minimum. This decrease is also confirmed by the susceptibility values which were measured. Most likely, the region of 5.4 to 5.7 electrons/atom is a two-phase equilibrium region of ordinary and antiferromagnetic states. The magnetic anisotropy can also serve as the source of the heat capacity anomaly. (SJR)

30579 MAGNETIC CHARACTERISTICS OF $LnCo_5-ThCo_5$ PSEUDOBINARY SYSTEMS. Wallace, W. E.; Swearingen, J. T. (Univ. of Pittsburgh). J. Solid State Chem.; 8: No. 1, 37-38 (Sep 1973).

Magnetic characteristics of $Ln_{1-x}Th_xCo_5$ ternaries, with Ln = Gd, Ho, or Er, are reported. This is introduced into the lattice in an effort to achieve ferromagnetic coupling. It is observed that the antiferromagnetic Ln–Co coupling, which exists in the $LnCo_5$ binaries, also persists in the ternaries. The cobalt moment and Curie temperature are reduced as the Th content of the sample is increased. The decreased cobalt moment is ascribed to electron transfer from Th to the cobalt d-shell. Failure to achieve ferromagnetism in the ternaries is ascribed to electron capture by cobalt, which prevents a rise in electron concentration as Th replaces Ln in the lattice. (auth)

30580 CRYSTAL-FIELD EFFECT ON A KONDO SYSTEM: MAGNETIC SUSCEPTIBILITY OF La:Ce. DeGennaro, S.; Borchi, E. (Instituto di Fisica dell'Università, Firenze 50125, Italy). Phys. Rev. Lett. 30: No. 9, 377-380 (26 Feb 1973).

In this paper we evaluate the effect of the cubic crystalline field on the magnetic susceptibility of the Kondo system La:Ce. We show the coexistence of the crystal-field splitting and the Kondo effect whenever the crystal field does not remove the degeneracy of the localized states completely. The theoretical curve is in good agreement with the experimental data for a choice of the Kondo temperature T_K=0.1 K. (auth)

30581 ATOMISTICS OF HELIUM DIFFUSION IN COPPER AND TUNGSTEN. Wilson, W. D.; Bisson, C. L. (Sandia Labs., Livermore, CA). Radiat. Eff.; 19: No. 1, 53-58(May 1973).

Using previously determined interatomic potentials, the activation energy for migration of a single substitutional helium atom in copper and tungsten was determined. The mechanism of migration involves the jump of the helium atom out of the vacancy concurrent with the jump of a host atom into that vacancy. The helium then occupies the vacant site created by the jumping host atom, resulting in a substitutional helium at a distance of $\sqrt{2}r_0(\sqrt{3}r_0)$ from its original site in copper (tungsten). The rate-limiting step in the process is found to be the jump of the helium out of the vacancy, the activation energy for which is 2.15 eV in copper and 4.69 eV in tungsten. (auth)

30582 THEORETICAL BASIS FOR THE USE OF RARE EARTHS IN MAGNETIC MATERIALS. Blasse, G. (Rijksuniversiteit, Utrecht). pp 281-295 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

From NATO Advanced Study Institute; Kjeller, Norway (23 Aug 1972).

Magnetic properties of rare earth (RE) compounds are dealt with. The origin of the magnetic moment of RE is described, and magnetic interactions between these moments are considered. Mechanisms in insulators are outlined and illustrated for some special cases (EuO, garnets, perovskites). In metallic conductors, the mechanism of the magnetic interaction is different because of the presence of conduction electrons. The examples here are (Eu, Gd)X, RE metals, compounds of RE and aluminum, and compounds of RE and the 3d-transition metals. Analogies and differences between the magnetic properties of RE and transition-metal compounds are outlined where necessary. (auth)

30583 COBALT-RICH REGIONS OF SAMARIUM–COBALT AND GADOLINIUM–COBALT PHASE DIAGRAMS. Buschow, K. H. J.; Den Broeder, F. J. A. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 33: 191-201 (1973).

The boundaries of the homogeneity regions of the phases $SmCo_5$, $GdCo_5$, and Gd_2Co_{17} were determined by microscopic investigation. At elevated temperatures the homogeneity region of the phases $SmCo_5$ and $GdCo_5$ extends to the Co-rich as well as to the Co-deficient side, whereas the phases Gd_2Co_{17} and Sm_2Co_{17} show almost no Co solubility. A tentative diagram is presented for the phase relationships involved in the transition between the two allotropic forms of Gd_2Co_{17}. The occurrence of various types of microstructures in as-cast and annealed RCo_5 samples is explained in terms of the peculiar shape of the solvus of the RCo_5 homogeneity regions at high temperatures. (auth)

30584 LOW-TEMPERATURE PROPERTIES OF $CeAl_2$ AND COMPARISON TO $LaAl_2$. Walker, E. (Univ., Geneva); Purwins, H. G.; Landolt, M.; Hulliger, F. J. Less-Common Metals; 33: 203-208(1973).

The total dilatation of $CeAl_2$ from 2.5 to 300°K was found to be similar to that of $LaAl_2$, thus making the assumption of a $Ce^{4+} \rightarrow Ce^{3+}$ transition unlikely. A negative peak in the dilatation curve of $CeAl_2$ coincides with the specific-heat peak at 3.36°K. A second transition occurs at 4.5 to 4.8°K. Magnetization measurements confirm the antiferromagnetism of $CeAl_2$. (25 references). (auth)

30585 RETENTION OF A METASTABLE BCC EPSILON–Pu SOLID SOLUTION: EPSILON–Pu(Ti). Elliott, R. O.; Russell, A. M.; Giessen, B. C. (Los Alamos Scientific Lab., NM). J. Mater. Sci.; 8: No. 9, 1325-1330(Sep 1973).

A metastable ϵ-Pu(bcc) solid solution was retained to room temperature by rapid quenching of Pu-rich Pu–Ti alloys from the liquid state. Until now, ϵ-Pu solid solutions were limited to high temperatures and had not been successfully quenched to room temperature without transformation. The apparatus used to quench the specimens was a modified "gun-type" splat-cooling unit, capable of producing extremely high cooling rates of from 10^6 to 10^8 °C sec^{-1}. ϵ-Pu(Ti) was retained in the composition region from ~20 to more than 45 at. % Ti, and extrapolation of the lattice parameter/composition curve yielded a value of a_0 = 3.53$_0$ Å for ϵ-Pu at 20°C. This modification differs from the ϵ-Pu modification derived by extrapolating from high temperature to 20°C by a small valence increase of ≈0.1. Metastable δ-Pu(Ti) (fcc) solid solutions were also quenched-in with alloys containing lesser amounts of Ti, and evidence was found to indicate that the δ was probably a product of ϵ-Pu(Ti) solid-state decomposition. (auth)

30586 STRUCTURAL AND MAGNETIC PROPERTIES OF THE $Y_{1-x}Th_xFe_3$ AND $Lu_{1-x}Th_xFe_3$ SYSTEMS. Kunesh, C. J.; Narasimhan, K. S. V. L.; Butera, R. A. (Univ. of Pittsburgh). J.Phys. Chem. Solids; 34: No. 11, 2003-2009(Nov 1973).

The structural and magnetic properties of the pseudobinary $Y_{1-x}Th_xFe_3$ and $Lu_{1-x}Th_xFe_3$ systems, having the $PuNi_3$ structure, were investigated. For $x \leq 0.3$, the magnetization vs temperature behavior for both systems is consistent with a simple ferromagnetic iron sublattice. For $x > 0.3$, both systems show anomalies in M vs T and M vs H data. Lattice constants for both systems show a monotonic increase with increasing thorium content. The anomalous magnetic behavior is explained by a Friedel-oscillation mechanism. (auth)

30587 MOESSBAUER EFFECT STUDIES OF CUBIC $^{237}NpM_3$ INTERMETALLIC COMPOUNDS. Gal, J. (Nuclear Research Center-Negev, Beersheba, Israel); Hadari, Z.; Bauminger, E. R.; Nowik, I.; Ofer, S. Solid State Commun.; 13: No. 6, 647-650 (15 Sep 1973).

The Moessbauer effect in ^{237}Np was used to investigate the hyperfine interactions in $NpPd_3$, $NpSn_3$, $NpGe_3$, and $NpRh_3$. $NpPd_3$ has a first-order magnetic transition at 49°K and $NpSn_3$ orders magnetically at 9°K. The saturation hyperfine fields in $NpPd_3$ and $NpSn_3$ are 3.35 MOe and 0.55 MOe, respectively. $NpGe_3$ and $NpRh_3$ do not order magnetically even at 1.7°K. The isomer shifts of the NpM_3 compounds change regularly with the size of the ($AuCu_3$ type) unit cell. (auth)

30588 MINIATURIZATION METHODS AND METALLURGY. Loria, E. A. J. Metals; 25: No. 5, 33-38(May 1973).

It is noted that micrometallurgical techniques provide rapid and low-cost scouting of new alloy fields. Proper techniques permit precise control of composition and assessment of properties. Results on vanadium, molybdenum, and stainless steel illustrate the merits of miniaturized research. Information is also included on melting and processing modes. (JRD)

30589 ELECTROTRANSPORT OF CARBON, NITROGEN, AND OXYGEN IN HAFNIUM METAL. Carlson, O. N.; Schmidt, F. A.; Sever, J. C. (Ames Lab., IA). Met. Trans.; 4: No. 10, 2407-2411 (Oct 1973).

The electrotransport velocities of carbon, nitrogen, and oxygen in alpha and beta hafnium were determined for the temperature range of 1650 to 2130° C. Diffusion coefficients and effective valences were also obtained for each solute. These data were used to predict the degree of purification achievable in a hafnium rod after electrotransport at 2000°C for different times. A comparison was made between the predicted and experimentally observed results. (auth)

30590 MECHANICAL BEHAVIOR OF CVD TUNGSTEN AT LOW TEMPERATURES. Lee, H. B.; Chun, J. S. (Univ. of Utah, Salt Lake City). pp 667-693 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From third international conference on chemical vapor deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

The effect of grain size, strain rate, and voids on the mechanical behavior of chemical-vapor-deposited tungsten were investigated over the temperature range of 77 to 365°K by compression tests. The flow stress increased linearly with decreasing temperature and a 0.2% offset yield stress as high as 206,000 psi was obtained at 77°K. The grain size and strain rate had pronounced effects on the flow stress. Scanning electron microscopy revealed that the fracture modes were both transgranular and intergranular. No deformation twinning was observed in any of the specimens after deformation and adequate ductility existed at low temperatures. (2 tables, 21 figures) (auth)

30591 RELATION BETWEEN MECHANICAL PROPERTIES AND MICROSTRUCTURE OF CHEMICALLY VAPOR DEPOSITED (CVD) TUNGSTEN AND RHENIUM. Sherwood, P. J. (Rocket Propulsion Establishment, Aylesbury, Eng.). pp 728-739 of Proceedings of the Third International Conference on Chemical Vapor Deposition. Glaski, F. A. (ed.). Hinsdale, IL; American Nuclear Society (1972).

From third international conference on chemical vapor deposition; Salt Lake City, Utah, USA (24 Apr 1972). See CONF-720410-.

Bend tests were carried out on CVD fluoride tungsten sheet to determine the ductile–brittle transition temperature (DBTT), and the resulting fracture surfaces were examined in the scanning electron microscope. It is concluded that the relatively high DBTT is due to the (100) growth texture which favors cleavage on (100) planes. The relation between the microhardness, ductility, and grain structure of CVD rhenium tubing produced by various techniques was also investigated. (11 figures, 11 references) (auth)

30592 EFFECT OF SOLUTES IN BINARY Nb ALLOYS ON CREEP STRENGTH. Klein, M. J.; Metcalfe, A. G. (International Harvester Co., San Diego, CA). Met. Trans.; 4: No. 10, 2441-2448(Oct 1973).

The effect of seven different solutes in binary Nb alloys on creep strength was determined from 1400 to 3400°F for solute concentrations to 20 at. % using a new method of creep-strength measurement. The technique permits rapid determination of approximate creep strength over a large temperature span. All of the elements were found to increase the creep strength of Nb except Ta. This element did not strengthen Nb until the concentration exceeded 10 at. %. Hafnium, Zr, and V strengthened Nb most at low temperatures and concentrations, whereas W, Mo, and Re contributed more to creep strength at high temperatures and concentrations. (auth)

30593 EFFECT OF SOLUTE INTERACTIONS IN Nb ON CREEP STRENGTH. Klein, M. J.; Metcalfe, A. G. (International Harvester Co., San Diego, CA). Met. Trans.; 4: No. 10, 2449-2454(Oct 1973).

The creep strength of 17 ternary Nb-base alloys was determined using an abbreviated measuring technique, and the results were analyzed to identify the contributions of solute interactions to creep strength. Isostrength creep diagrams and an interaction strengthening parameters, S_T, were used to present and analyze data. It was shown that the isostrength creep diagram can be used to estimate the creep strength of untested alloys and to identify compositions with the most economical use of alloy elements. Positive values of S_T were found for most alloys, showing that interaction strengthening makes an important contribution to the creep strength of these ternary alloys. (auth)

30594 RELATIONSHIP BETWEEN DEFORMATION TWINNING AND THE STRESS–STRAIN BEHAVIOR OF POLYCRYSTALLINE TITANIUM AND ZIRCONIUM AT 77°K. Garde, A. M.; Aigeltinger, E.; Reed–Hill, R. E. (Univ. of Florida, Gainesville). Met. Trans.; 4: No. 10, 2461-2468(Oct 1973).

Stress–strain curves at 77°K of high-purity Zr, commercial-purity Zr, high-purity Ti, and commercial-purity Ti, which are all significantly different, were analyzed by the Crussard and Jaoul method. The evolution of the mechanical twin structure in these specimens was also studied using quantitative optical microscopy. It was generally observed that changes in the nature of the twin structure development correlated with changes in the C-J deformation stages. Constant work hardening rate stages tend to appear at higher strains if the rate of increases of the twin volume fraction is large. (auth)

30595 MAGNETIC PROPERTIES OF NEODYMIUM–SAMARIUM–COBALT ALLOYS. Frederick, W. G. D. Cincinnati; Univ. of Cincinnati (1973). 129p. University Microfilms Order No. 73-22,753.

Thesis (Ph. D.).

A vibrating sample magnetometer was utilized to determine the magnetization parallel and perpendicular to the c-axis of single crystals of YCo_5 and the pseudo-binary alloy system $Nd_{1-x}Sm_xCo_5$ (with x = 0.00, 0.25, 0.50, 0.75, and 1.00) over the temperature range from 4.2 to 1000°K. A least squares fit was made to the perpendicular or parallel magnetization (according to whether the easy direction of magnetization was along the c-axis or in the basal plane, respectively) for a plot of H_{eff}/M versus M^2 to obtain a straight line. The magnetocrystalline anisotropy constants K_1 and K_2 were calculated from the intercept and slope, respectively, of the straight line fit to the data at a fixed temperature. The saturation magnetization was determined from extrapolation of an isothermal magnetization curve in the easy direction to zero magnetic field. The Curie temperature was derived from the temperature dependence of the remanent magnetization. For YCo_5, K_1 and K_2 at 296°K were found to be $5.683 \pm 0.003 \times 10^7$ ergs/cm^3 and $1.738 \pm 0.152 \times 10^7$ ergs/cm^3, respectively. K_1 is in agreement with values found in the literature. The temperature dependence of the reduced magnetization was found to follow a Brillouin function for $J = 1/2$ over the temperature range from 4.2 to 900°K. The Curie temperature of YCo_5 was found to be 895 ± 2°K, which is in good agreement with a previous measurement (903°K). K_1 for $SmCo_5$ at 296°K was found to be $18.11 \pm 0.03 \times 10^7$ ergs/cm^3 and the anisotropy field was calculated to be 400 kOe, which are the highest values ever reported for any material at 300°K. At 4.2°K, anisotropy in the basal plane in $NdCo_5$ could be described by an anisotropy constant $K_4 = 1.03 \pm 0.10 \times 10^7$ ergs/cm^3. The anisotropy constants K_1 and K_2 of the pseudo-binary alloy system $Nd_{1-x}Sm_xCo_5$ were not linearly dependent on composition, thereby suggesting that the single-ion model of anisotropy is not applicable for this system. The deviation from linear behavior could be accounted for by subregular solution theory and the composition dependence of the anisotropy constants at 4.2°K can be described by $K_1 = -67.41 \times 10^7 + 95.60 \times 10^7\,x + 108.26 \times 10^7 \times (1-x) - 102.29 \times 10^7\,x^2\,(1-x)$ ergs/cm^3 and $K_2 = 35.15 \times 10^7 - 35.32 \times 10^7\,x - 103.68 \times 10^7 \times (1-x) + 145.39 \times 10^7\,x^2\,(1-x)$ ergs/cm^3. However, the magnetization was found to be linearly dependent on composition in this system: $M_s(O) = 1122 - 145.9 \times$ emu/cm^3. The reduced magnetization for both $NdCo_5$ and $SmCo_5$ were found to follow a Brillouin function for $J = 7/2$ over the temperature range from 4.2 to 1000°K. The Curie temperatures of $NdCo_5$ and $SmCo_5$ were found to be 925 ± 2°K and 986 ± 2°K, respectively, in agreement with published values. (Diss. Abstr. Int., B.)

30596 CRITICISM OF THE MEASUREMENT METHOD OF THERMAL DIFFUSIVITIES BY LASER IRRADIATION. Barsanti, G.; Ciampi, M.; Latrofa, E.; Tuoni, G. (Univ., Pisa, Italy). Termotecnica (Milan); 27: No. 8, 419-424(Aug 1973). (In Italian).

The thermal diffusivity of different specimens of cadmium was measured by use of the "flash method". On the basis of the experimental data, possibilities and limits of such a method are analyzed. The errors arising from the nonuniformity of irradiation are also extensively discussed. (auth)

30597 APPROXIMATE ANALYTIC REPRESENTATION OF THE CONDUCTION BAND OF LANTHANUM. Ramakanth, A. (Saha Inst. of Nuclear Physics, Calcutta); Kumar, S. Phys. Status Solidi (a); 18: No. 2, K125-K128(16 Aug 1973).

A least square fit of the conduction band of La is presented. Functions and coefficients of the fit are tabulated along with root mean square error. These values are the basis of a conclusion that the four-parameter expression described in the note gives a good approximation of the conduction band. (JRD)

30598 DOMAINS IN SINTERED Co_5Sm MAGNETS. Livingston, J. D. (General Electric Corporate Research and Development, Schenectady, NY). Phys. Status Solidi (a); 18: No. 2, 579-588(16 Aug 1973).

Magnetic domains in high-coercivity sintered Co_5Sm magnets were studied using polarized light. Grain boundaries block the propagation of magnetic reversal from grain to grain. General

domain-wall pinning is low, and oversized grains show low-coercivity, multidomain behavior. In most grains, however, once domain walls are removed, large reverse fields are required to nucleate magnetization reversal. (auth)

30599 MOESSBAUER STUDIES OF DECOMPOSITION AND ORDERING IN Fe–23 at. % Be ALLOYS AGED AT 300°C. Yagisawa, K. (National Research Inst. for Metals, Tokyo). Phys. Status Solidi (a); 18: No. 2, 589-596(16 Aug 1973).

Modulated structures in Fe–23 at.% Be alloys aged at 300°C were studied by the Moessbauer effect. The Be concentration and the volume fraction of the higher Be concentration region (region H) increase with increasing aging time and, correspondingly, those of the lower Be concentration region (region L) decrease. The degree of order in region H increases monotonically with increasing aging time, whereas in region L it decreases to zero for 13 at. % Be. From the analysis of the internal fields, the distribution of conduction electrons is found to be fairly uniform over the regions H and L. The ratio of the spin densities at the Fe atom site itself, at its nearest and next nearest neighbor sites, $H_s : H_m : H_n$, is determined to be 1 : –0.076 : –0.038. (auth)

30600 ELECTRON MICROSCOPY OF AMORPHOUS Gd–Co ALLOY THIN FILMS. Herd, S. R.; Chaudhari, P. (IBM Watson Research Center, Yorktown Heights, NY). Phys. Status Solidi (a); 18: No. 2, 603-611(16 Aug 1973).

Transmission electron microscopy and electron diffraction were used to study the structural changes in amorphous Gd–Co films with temperature, while Lorentz microscopy was employed to reveal the related magnetic changes. Amorphous Gd–Co films in the composition range of 75 to 85 at. % Co precipitate small face centered cubic Co crystals in an amorphous matrix after heating at 400°C. As deposited, these films were found to contain stripe as well as in-plane domain structures. Magnetic bubbles as small as 800 Å could be generated in as-deposited amorphous as well as partially crystallized films. In films with less than 79 at. % Co, the magnetic compensation point was demonstrated by a reversible reversal of domain contrast with temperature. (auth)

30601 PSEUDOPOTENTIAL CALCULATION OF THE ELECTRONIC STRUCTURE OF A TRANSITION METAL: NIOBIUM. Fong, C. Y. (Univ. of California, Davis); Cohen, M. L. Phys. Lett., 44A: No. 5, 375-376(2 Jul 1973).

Electronic structure and density of states are calculated for niobium using the empirical-pseudopotential method with a non-local d-potential. Results are in good agreement with APW calculations for states near and below E_F, indicating that the niobium pseudopotential obtained can be used for pseudopotential calculations of niobium compounds. (auth)

30602 CREEP EFFECTS ON MOLYBDENUM DEFORMATION AND FRACTURE. Zelenyuk, E. E.; Krivenyuk, V. V.; Semirog Orlik, V. N. (Inst. of Problems of Solids, Kiev). Probl. Proch. Mashinostr.; No. 12, 85-89(Dec 1972). (In Russian).

Results of tests on the creep and long-term stability in a vacuum at temperatures of 1000 to 1800°C of samples of commercially pure Mo are reported. The results of the study of the concentration of deformation in the cross section of the beam under great stress near the cut are also studied. It is established that the effect of the concentrator on the stability of the material as a function of the test conditions can be qualitatively and quantitatively different. The coefficients of the concentration of stress and deformation in the elastic range coincide, and the latter does not depend on the magnitude of the plastic deformation within large limits. (tr-auth)

30603 THERMAL EXPANSION OF InBi. Takano, K.; Sato, T. (Tokyo Metropolitan Univ.). Phys. Lett.; 44A: No. 5, 309-310 (2 Jul 1973).

Linear thermal expansion of InBi single crystal was measured between –186 and 100°C. Lattice constant a shows normal behavior over the measured temperature range. Lattice constant c, however, contracts monotonically with increasing temperature in this range. (auth)

30604 SOME REGULARITIES IN DEFORMATION AND FRACTURE OF HEAT-RESISTANT MOLYBDENUM-, NIOBIUM-, AND TANTALUM-BASE ALLOYS UNDER CYCLIC TEMPERATURE CHANGE CONDITIONS. Troschenko, V. T.; Uskov, E. I. (Inst. of Problems of Solids, Kiev). Probl. Proch. Mashinostr.; No. 12, 8-14(Dec 1972). (In Russian).

The results of a study of creep and long-term stability of a series of refractory Mo-, Nb-, and Ta-base alloys under conditions of cyclic temperature changes are reported. The regularities of the deformation and fracture of the alloys under these conditions are examined. It is shown that thermal cycling causes an increase of the creep rate, reduction of the ductility, and significant decrease of the time to fracture of the alloys studied in comparison with isothermal tests. The exponential regularity between stress and time to fracture is established. (tr-auth)

30605 DISPERSION RELATIONS AND LATTICE THERMAL EXPANSION OF DYSPROSIUM. Rao, R. R.; Menon, C. S. (Indian Inst. of Tech., Madras). J. Phys. Chem. Solids; 34: No. 11, 1879-1886(Nov 1973).

The lattice dynamics, second and third order elastic constants, and the lattice thermal expansion of dysprosium have been calculated using Keating's (Phy. Rev., 145: 637(1966) and 149: 674 (1966)) approach. The ten third-order elastic constants are calculated using four anharmonic parameters. The model reproduces the measured pressure derivatives of the second-order elastic constants of dysprosium well. The low- and high-temperature limits $\bar{\gamma}_L$ and $\bar{\gamma}_H$ of the lattice thermal expansion are evaluated, and the agreement between the calculated $\bar{\gamma}_H$ and that obtained from the thermal expansion and specific heat data is satisfactory. (auth)

30606 STRENGTH DIFFERENTIAL EFFECT IN ZIRCONIUM ALLOYS. Mannan, S. L.; Rodriguez, P. (Bhabha Atomic Research Centre, Trombay, India). Scr. Met.; 7: No. 10, 1069-1074(Oct 1973).

A study was made of the effects of interstitial (O,N) content on the strength differential (SD) effect, which refers to the difference in compressive and tensile strengths. The materials were prepared by melting of iodide and sponge zirconium; earlier data for longitudinal and transverse Zircaloy-2 are also included. Results show that the SD increases with increasing interstitial content, and that the model of Hirth and Cohen (Met. Trans. 1 : 3 (1970)) is favored over that of Snowden (Scr. Met. 5: 467(1971)). (DLC)

30607 FATIGUE DEFORMATION IN A Zr–O ALLOY IN RANGE 20 to 700°C (0.15 TO 0.53 T_{mr}). Snowden, K. U.; Stathers, P. A. (Australian Atomic Energy Commission Research Establishment, Sutherland). Scr. Met.; 7: No. 10, 1097-1100(Oct 1973).

Zr containing 3300 ppM O was tested in vacuum in reverse-plane bending fatigue at a frequency of 17 Hz. The fatigue life at a strain amplitude of ±0.30% shows a sharp peak at ~300°C. Metallographic observations were also made of the deformation and slip. Results indicate that fatigue strengthening occurred at ~300°C, and that surface slip was more uniformly dispersed at this point. (DLC)

30608 ELECTRON MICROSCOPY OF HYDRIDE PRECIPITATES IN NIOBIUM. Schober, T. (Kernforschungsanlage, Juelich, Ger.). Scr. Met.; 7: No. 10, 1119-1124(Oct 1973).

Transmission electron microscopic (TEM) observations are presented on the morphology of hydride precipitates and on new low-temperature phase transitions within the precipitates. Nb foils were hydrogen-charged and electropolished for TEM at –160°C; H concentrations were chosen so that precipitation occurred during the cooldown. Very large areas (>0.1 mm dia) which were completely in the hydride phase, and hydride phase containing periodic arrays of lenticular plates of the α-phase (matrix) were observed. Diffraction analysis of the observed hydrides showed that ϵ-Nb_4H_3 transforms at –65°C into the ζ-phase, which in turn transforms at –45°C into the β-phase. (DLC)

30609 ONSET OF SERRATED FLOW IN Cu–Be ALLOYS. Jovanovic, M. (Boris Kidric Inst., Belgrade); Drobnjak, D. Scr. Met.; 7: No. 10, 997-1002(Oct 1973).

The effects of strain rate $\dot{\epsilon}$ on the critical strain ϵ_c for the onset of serrated flow were studied for Cu alloys containing 1.0, 1.5, and 2.0 wt % Be at 90, 120, 150, and 180°C. The relation $\epsilon_c = k\dot{\epsilon}^{1/(m+\beta)}$ is obeyed, except for an inversion at high temperatures, and the $(m + \beta)$ values derived from the slopes are tabulated and compared with literature data for other Cu and Al alloys. Possible reasons for the observed behavior, including trapping, strain aging, G.P. zones, etc., are discussed. 22 references. (DLC)

30610 NECKING STRAIN OF ZIRCALOY-4 IN THE DYNAMIC STRAIN-AGING RANGE. Boratto, F. J. M. (Cidade Universitaria, Belo Horizonte, Brazil); Cetlin, P. R.; Veado, J. T. Scr. Met.; 7: No. 10, 1031-1036(Oct 1973).

The analysis of the variation with temperature of the stress strain rate sensitivity (n), work-hardening strain rate sensitivity (s), and ductility of Zircaloy-4 seems to explain reasonably well the variation of the necking strain of this metal with temperature, in the dynamic strain aging range. The minimum in the necking strain at about 400°C is probably associated with minima in the above three parameters. The localized maximum at about 550°C is probably associated with a maximum in s and in ductility. (auth)

30611 MECHANISM OF THE UNEXPECTED [110] SLIP OBSERVED IN BCC METALS DEFORMED AT LOW TEMPERATURES.

Matsui, H.; Kimura, H. (Tohoku Univ., Sendai). Scr. Met.; 7: No. 9, 905-914(Sep 1973).

Activation of low stressed [1$\bar{1}$1] ($\bar{1}$01) and/or [111] ($\bar{1}$01) slip systems has been previously observed in Nb, Ta, Mo, W, and Fe–3% Si. A mechanism is presented which is based on the dislocation–surface interaction and the fact that mixed dislocations can move at considerably lower stress than screws. A simplified calculation is given, and it is shown that many of the anomalous features of the unexpected ($\bar{1}$01) slip can be explained with the mechanism. 5 figures, 19 references. (DLC)

30612 SURFACE AND TRAPPING EFFECTS ON HYDROGEN DIFFUSION IN BCC METALS. Birnbaum, H. K. (Univ. of Illinois, Urbana). Scr. Met.; 7: No. 9, 925-930(Sep 1973).

Possible sources of experimental difficulty are discussed in applying high-temperature methods which require the transport of H across a solid–vapor interface. The large amount of scatter in the data for H diffusivity in refractory metals is pointed out. According to thermodynamics the permeation of H must be accompanied by oxidation or nitridation films or by the diffusion of O and N. Since the H can be trapped at other interstitials such as O, this results in a large flux of trapping sites into the specimen along with the H flux. The trapping can qualitatively account for the high-temperature H diffusivity data; reliable data in the future will depend on much better vacuum and gas purity conditions. (3 figures, 25 references). (DLC)

30613 INVESTIGATION OF TERNARY SYSTEM Ir–Ta–Ni. Bernard, V. B.; Kuprina, V. V.; Burnashova, V. V. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 3, 350-353(1973). (In Russian).

An isothermal section for the system Ir–Ta–Ni at 950°C was obtained. Four new intermetallic phases denoted by A, X, Y, and Z have been revealed. (auth)

30614 ELECTRONIC PHASE TRANSITION IN Ce_{1-x} La_x ALLOYS. Alascio, B. (Univ. Nacional de Cuyo, Rio Negro, Argentina); Lopez, A.; Olmedo, C. F. E. Phys. Rev.; B; 7: No. 10, 4743-4745(15 May 1973).

An extension of the Ramirez–Falicov theory of the α-γ transition in Ce is given which accounts for the effect of rare-earth impurities, particularly La. (auth)

30615 MORE ON THE ELECTRONIC PHASE TRANSITIONS OF $Ce_{1-x}La_x$ ALLOYS. Ramirez, R. (Universidad Catolica, Santiago de Chile); Kiwi, M. Phys. Rev., B; 7: No. 10, 4745-4747(15 May 1973).

The models for electronic phase transitions of $Ce_{1-x}La_x$ alloys are critically examined. The ideas put forward in the preceding paper are shown to be inconsistent and to lead to unphysical results. An experimental test is suggested to decide on the validity of the proposed model. (auth)

30616 CALCULATION OF THE THERMAL AND ELECTRICAL CONDUCTIVITIES OF MELTS OF CERTAIN METALS. Dul'nev, G.N.; Zarichnyak, Y.P. High Temp. 10: No. 4, 692-697 (Mar 1973).

A model is proposed for the structure of a binary melt, and a method is proposed for calculating its effective thermal and electrical conductivities from the known thermal conductivities, and concentrations of the components. (auth)

30617 MAGNETIC STRUCTURES OF CeSb AND GdSb BY MOESSBAUER SPECTROSCOPY OF ^{121}Sb. Shenoy, G. K. (Centre National de la Recherche Scientifique, Strasburg); Friedt, J. M.; Dunlap, B. D.; Vogt, O. pp 24 of Hyperfine Interactions Detected by Nuclear Radiation. Liege; Univ. Liege (1973). (In French).

From hyperfine interactions detected by nuclear radiation; Liege, Belgium (11 Sep 1973).

The Moessbauer spectra of ^{121}Sb in CeSb and GdSb were measured at 77 and 4.2°K. The magnetic field of saturation at the site of the antimony nuclei in the antiferromagnetic state in the matrix of CeSb (T_N = 16°K) is 64 (±4) kOe. At 4.2°K, a unique magnetic field is exerted on all the nonmagnetic Sb ions; it is shown that the magnetic structure of CeSb is of Type I or Type IA at this temperature. The existence of a structure of type IA was deduced from a recent neutron-diffraction study. The origin of the difference in magnetic fields at the site of ^{121}Sb in the matrices of CeSb and USb is discussed. No magnetic field is exerted at the site of ^{121}Sb in the antiferromagnetic state of GdSb. From this it is deduced that the magnetic structure of this last matrix is Type II. (tr-auth)

30618 TEMPERATURE DEPENDENCE OF THE PROBABILITY FOR SCATTERING OF CHARGE CARRIERS IN MOLYBDENUM AND TUNGSTEN. Boiko, V. V.; Gantmakher, V. F.; Gasparov, V. A. (Inst. of Solid State Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 3, 1219-1226(Sep 1973). (In Russian).

Experimental information on the probability for scattering of charge carriers at various sections of the Fermi surface of molybdenum and tungsten is obtained in investigations of the temperature dependences of the radio-frequency size effect line amplitudes carried out in the 1.5 to 12°K range. The temperature-dependent part of the collision frequency for molybdenum is found to be proportional to T^2 up to 12°K. A quadratic dependence is observed in tungsten only below about 6°K; a T^3 law is observed above this temperature. An attempt is made to analyze the possible contribution of electron–electron scattering to the observed temperature dependences. On basis of available information on the electron spectra of molybdenum and tungsten and on the shape of their Fermi surfaces, a comparison is carried out with nontransition metals. (auth)

30619 IMPLANTATION OF ^{129m}Te IN Fe AND Ni FOILS AND DETERMINATION OF THE HYPERFINE FIELDS. Coussement, R.; Dumont, G.; Langouche, G.; Pattyn, H.; Rots, M.; Schmidt, K. P.; van Rommum, M. (Univ., Louvain, Belgium). pp 18 of Hyperfine Interactions Detected by Nuclear Radiation. Liege; Univ. Liege (1973).

From hyperfine interactions detected by nuclear radiation; Liege, Belgium (11 Sep 1973).

The Moessbauer effect was used to find the positions of ions of ^{129m}Te implanted at 75 kV. For iron, only one implantation site is found up to implantation doses as high as 10^{15}/cm^2. However, at an implantation dose of 10^{16}/cm^2, two sites corresponding to two magnetic hyperfine fields are found. For implantations in Ni even at low doses, a complex spectrum corresponding to at least two implantation sites is found. The hyperfine fields are: H_{high} (I Fe) = + 1139 ± 5 kG; H_{low} (I Fe) = + 220 ± 10 kG; H_{high} (I Ni) = + 293 ± 3 kG. The spectra (I,Fe) show an asymmetry between the two deepest peaks, which is evidence of a small quadrupole interaction with e^2qQ ($3\cos^2\theta - 1$) ≤ 30 MHz, where θ is the angle between the E.F.G. z-axis and the magnetic hyperfine field. This interaction may be attributed to magnetostrictive deformation of the crystal structure. The spectra of (I,Ni) too show a large asymmetry but these spectra are more complex (two implantation sites). (DLC)

30620 ALLOYS OF TITANIUM WITH REFRACTORY ELEMENTS. Solonina, O. P.; Ulyakova, N. M. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 3-4, 310-312(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 3-4, 39-43(1973).

The mechanical properties, structure, and phase composition of binary Ti alloys with up to 30% Mo, V, and Cr. and up to 60% Nb, and ternary and more complex alloys with up to 40% refractory metals Mo, Nb, V, and Cr were investigated. Alloys with a high concentration of alloying elements (30 to 40%) have a lower plasticity than α and $\alpha + \beta$ alloys. Most of the β titanium alloys investigated have a low heat resistance and high ductility at 650°C compared with existing α and $\alpha + \beta$ alloys. The Ti–Mo–Nb–Cr and Ti–Mo–Nb–V–Cr alloys with a total of 30 to 40% alloying elements are the most heat resistant. The heat resistance of β alloys can be increased by combined alloying of the β solid solution and intermetallic hardening. (auth)

30621 OXYGEN IN ALLOYS OF TITANIUM WITH ALUMINUM AND ZIRCONIUM. Kornilov, I. I.; Peradze, T. A.; Valilova, V. V.; Fatkullina, L. P.; Korobov, O. S. (Inst. of Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 3-4, 306-309(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 3-4, 36-39(1973).

The effects of zirconium in alloys of titanium with aluminum and oxygen and the effect of oxygen in alloys with aluminum and zirconium were investigated by means of electron and x-ray diffraction microanalysis. The modulus of elasticity, electrical resistivity, hardness, and mechanical properties were determined. The alloys were melted in a cold hearth furnace using a consumable electrode in argon. The original materials were TG-110 titanium sponge, AV000 aluminum, iodide zirconium, and Ti–O and Ti–Al master alloys with 15.8% O and 35.8% Al. The alloys were remelted twice in a vacuum arc furnace and ingots weighing 9 kg were ground to remove surface defects and forged at 1100 to 1150°C to bars. It was found that Ti–Al–Zr alloys can contain an elevated oxygen concentration, although the aluminum concentration must be limited at 2 to 2.5% and the zirconium concentration at 2 to 5%. Embrittlement with the addition of a large amount of aluminum is due to the lower solubility of aluminum in the Ti–Al–Zr–O system as compared with the Ti–Al system and the precipitation of ordered α_2 phase. In Ti–Al alloys α_2 phase is precipitated at 6 to 6.5% Al, in Ti–Al–O alloys at 4.5% Al, and at 3.5% Al in alloys with zirconium and oxygen. (JRD)

30622 NEUTRON CRYSTAL FIELD SPECTROSCOPY IN $Tm_{0.25}Y_{0.75}Al_2$. Furrer, A.; Buehrer, W.; Heer, H.; Purwins, H. G.; Walker, E. (Eidgenoessisches Inst. fuer Reaktorfor-

schung, Wuerenlingen, Switzerland). Int. J. Magn.; 4: No. 1, 63-69(Mar 1973).

The energy distribution of neutrons scattered by polycrystalline $Tm_{0.25}Y_{0.75}Al_2$ was studied in the paramagnetic phase. The intensity arising from crystal field transition was identified by its temperature dependence as well as by comparison with corresponding "nonmagnetic" YAl_2 spectra. Because of the small crystal-field splittings and line-broadening effects, it was not possible to separate the crystal-field transition peaks. A least-squares fitting procedure was applied to the experimental data in order to obtain the best possible crystal field parameters. Two-phonon processes have to be taken into account in analyzing the measured energy spectra. The best fit is obtained for the Lea, Leask and Wolf (J. Phys. Chem. Solids, 23: 1381(1962)) parameters $x = 0.50 \pm 0.05$ and $W = 0.040 \pm 0.005$ MeV. The resulting crystal-field level scheme agrees qualitatively with estimates based on a nearest-neighbor point charge model and quantitatively with the experimentally determined susceptibility of $Tm_cY_{1-c}Al_2$ ($c = 0.25, 0.15, 0.05$) extrapolated to $c = 0$. (auth)

30623 MAGNETIC PROPERTIES OF RARE EARTH INTERMETALLIC COMPOUNDS. Barbara, B.; Gignoux, D.; Givord, D.; Givord, F.; Lemaire, R. (Centre National de la Recherche Scientifique, Grenoble, France). Int. J. Magn.; 4: No. 1, 77-83(Mar 1973).

The crystal structures of rare earth compounds with M = Fe, Co, Ni, or Al are divided into two groups. In the first, the structures are derived from that of $CaCu_5$. The M–M distances are short and the magnetic interactions due to M atoms determine the magnetic properties. Especially, they involve antiparallel coupling between rare earth and M spins. Some of the RCo_5 compounds show good permanent magnet properties ($SmCo_5$). However, the stabilization of the $CaCu_5$ phase by replacing pairs of Co for rare earths locally decreases the anisotropy and so facilitates reverse domain nucleation (YCo_5). For Co or Ni compounds the magnetic properties are mainly determined by the modification of electronic configuration of Co or Ni. On the contrary, the magnetic properties of Fe compounds depend essentially on the number of Fe nearest neighbors and on their interatomic distances. The structures of the compounds in the second group are described with trigonal prisms whose arrangement leads to a low symmetry. The crystal-field effects are generally larger than the exchange effects due to the rare earths. The domain walls can be frozen by the anisotropy, which leads to an unusual magnetization process. (auth)

30624 PRESSURE-TEMPERATURE PHASE DIAGRAM OF $Ce_{1-x}La_x$. Plischke, M. (McGill Univ., Montreal); Zuckermann, M. J.; Kiwi, M.; Ramirez, R. J. Phys., F (London); 3: No. 9, 1746-1751(Sep 1973).

A proposal is made for a simple extension of a model of Ramirez and Falicov (Phys. Rev., B3: 2425-30(1971)) for cerium to account for the room-temperature variation of the critical pressure of the $\alpha-\gamma$ transition in Ce–La alloys with lanthanum concentration. The theory predicts a first-order phase transition at all concentrations and a change of magnetic susceptibility that is independent of concentration. It is found that the experimental results can be reproduced. (auth)

30625 PHONON DISPERSION IN YTTRIUM AND TERBIUM. Upadhyaya, J. C.; Verma, M. P. (Agra Coll., India). J. Phys., F (London); 3: No. 9, 1672-1677(Sep 1973).

A phenomenological model of the lattice dynamics of hcp metals is developed by adding a modified Sharma-Joshi electron–ion interaction term to a five-neighbor central pair potential. The equilibrium condition derived from the potential system is shown to agree with the rotational-invariance condition for the system. The model is used to study phonon dispersion in Y and Tb and is found to give reasonably good agreement with the experimental dispersion curves. (auth)

30626 DIRECTIONAL PHOTOEMISSION FROM THREE TUNGSTEN SINGLE-CRYSTAL FACES. Feuerbacher, B.; Fitton, B. (Surface Physics Division, European Space Research Organisation, Noordwikj, Holland). Phys. Rev. Lett. 30: No. 19, 923-926 (7 May 1973).

Energy distribution spectra have been measured for photoelectrons emitted normal to three tungsten single-crystal faces, namely (100), (110), and (111), for photon energies between 7.7 and 11.7 eV. The spectra show marked differences for the different faces, in agreement with the assumption that the electrons originate from states along different symmetry lines in the Brillouin zone. Structure in the spectra is interpreted in terms of emission due to direct optical interband transitions and surface photoelectric emission. (auth)

30627 COMPOSITIONAL AND TEXTURE ANALYSIS OF TANTALUM THIN FILMS BY ENERGY DISPERSIVE X-RAY ANALYSIS. deBen, H.S.; Broyde, B. (Engineering Research Center, Western Electric Company, Princeton, New Jersey, 08540). Appl. Spectrosc. 27: No. 2, 99-102 (Mar 1973).

Quantitative measurements of concentrations are given for the phases present in undoped tantalum thin films by the use of energy-dispersive x-ray detectors. This diffraction method can also yield the extent of preferred orientation. (auth)

30628 METALLIC RADII AND ELECTRON CONFIGURATIONS OF THE 5f-6d METALS. Zachariasen, W. H. (Univ. of Chicago). J. Inorg. Nucl. Chem.; 35: No. 10, 3487-3497(Oct 1973).

The experimental radii for all d and f transition metals are given. The set of radii refers to twelve coordination and is based on the observed atomic volumes of the metals. The empirical correlation between metallic radius, the number of bonding electrons and the number of f electrons is used to deduce the metallic valence for the 5f-6d metals. The conclusions presented twenty years ago for the metals Th, Pa, U, Np have been confirmed, and the deductions as to metallic valence have been extended to include all the metals Fr, Ra, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es. (auth)

30629 ELASTIC PROPERTIES OF RARE-EARTH-IRON COMPOUNDS. Clark, A.E.; Belson, H.S. (Naval Ordnance Laboratory, Silver Spring, Maryland 20910); Strakna, R.E. J. Appl. Phys. 44: No. 6, 2913-2914 (June 1973).

Ultrasonic velocities have been measured and used to determine the elastic moduli of the highly magnetostrictive compounds: $TbFe_2$, $TbFe_3$, and $ErFe_2$. A huge ΔE effect of 90% has been calculated for $TbFe_2$ from our static stress-strain data. (auth)

30630 LIQUID-PHASE SINTERING OF $SMCO_5$. Jorgensen, P.J. (Stanford Research Institute, Menlo Park, California 94025); Bartlett, R.W. J. Appl. Phys. 44: No. 6, 2876-2880 (June 1973).

The initial sintering kinetics of stoichiometric $SmCo_5$ powder containing a samarium-rich sintering addition (60 wt% Sm plus 40 wt% Co) have been investigated as a function of amount of liquid phase, time, temperature, and particle size. The shrinkage as a function of time exhibits the classical three stages of liquid-phase sintering, i.e., rearrangement, solution precipitation, and solid phase. The rate-controlling step during the solution-precipitation stage corresponds to a phase-boundary (solid/liquid) reaction leading to dissolution. Evidence for this conclusion is partially based on the logarithm-shrinkage-logarithm-time slopes being equal to 1/2 instead of 1/3. A 1/3 slope is predicted by the liquid-diffusion-controlled sintering model while the phase-boundary sintering model predicts a slope of 1/2. An activation energy of 52.8 kcal/mole was obtained for the temperature dependence, and this also suggests a phase-boundary reaction rather than rate control by diffusion in the liquid phase. The rate of sintering follows an r^{-1} particle-size dependence instead of an $r^{-4/3}$ dependence, again suggesting that the solution-precipitation stage of sintering of $SmCo_5$ is controlled by a phase-boundary reaction leading to dissolution. (auth)

30631 LASER-INDUCED ANISOTROPIC THERMOELECTRIC VOLTAGES IN THIN FILMS. von Gutfeld, R.J. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Appl. Phys. Lett. 23: No. 4, 206-208 (15 Aug 1973).

Transverse thermoelectric voltages have been observed to occur when thin Mo and W films are excited by pulsed laser light at normal incidence to the film. Wavelengths in the range 0.46–1.06 μm and pulse widths of ∼ 3–300 nsec were used. A maximum thermoelectric voltage of ∼ 50 mV occurring across a load resistance of 50 Ω for an ∼ 1-kW incident laser pulse has been observed. A correlation between intrinsic film stress and output voltage suggests that the stress gives rise to a nonscalar absolute thermoelectric power (Seebeck coefficients) even though the transport properties of these bulk materials are isotropic. (auth)

30632 MAGNETIC PHASE TRANSITION IN TM_2FE_{17}. Gubbens, P.C.M. (Interuniversitair Reaktor Institut, Delft, The Netherlands); Buschow, K.H.J. J. Appl. Phys. 44: No. 8, 3739-3741 (Aug 1973).

The magnetization and the Mössbauer effect were studied for Tm_2Fe_{17} as a function of temperature in the range 4.2–350 K. The results indicate a magnetic phase transition near 72 K. (auth)

30633 THERMODYNAMICS OF THE FIRST PHASE OF EXPLODED CONDUCTORS. Vlastós, A.E. (The Royal Institute of Technology, S-100 44 Stockholm 70, Sweden). J. Appl. Phys. 44: No. 8, 3593-3600 (Aug 1973).

For cylindrical conductors made of thin copper and tungsten and heated by the electrical pulse from a high-voltage condenser bank which had inductance and resistance much lower than those of the conductors, the following items were studied as functions of the diameter and the applied voltage: (i) the variations in time of the temperature and resistance of the conductors up to the time they reach their melting points; (ii) the dips on the recordings of the current derivative and the voltage across the conductors which appear near their melting points; (iii) the first current-pulse crest and the time to the current-pulse crest,

as well as the influence of the ambient pressure on the current crest and on the time to the current crest; and (iv) the events occurring at the tail of the first current pulse and the beginning of the dwell time, which may have a decisive effect on the type of restrike mechanism which will follow the conductor explosion. (auth)

30634 STRUCTURE AND THERMAL STABILITY OF SPUTTERED AU–TA FILMS. Christou, A.; Day, H. (Naval Research Laboratory, Washington, D. C. 20375). J. Appl. Phys. 44: No. 8, 3386-3393 (Aug 1973).

The structure and thermal stability of bimetallic Au–Ta films has been studied by x-ray diffraction, electrical resistivity, and by microscopy. Annealing above 450 °C forms a TaAu compound. The growth of the TaAu layer at the Au–Ta interface follows a parabolic rate law. A low-temperature depletion of gold at tantalum grain boundaries occurs below 350 °C with an activation energy of 0.41 eV. Grain growth occurs with an activation energy of 0.50–0.55 eV for gold and 0.40–0.50 eV for tantalum. Thermal stresses of the order of 1.0×10^9 dyn/cm² exist in the sputtered films. (auth)

30635 ELASTIC PROPERTIES OF TANTALUM OVER THE TEMPERATURE RANGE 4–300 K. Leisure, R.G.; Hsu, D.K.; Seiber, B.A. (Department of Physics, Colorado State University, Fort Collins, Colorado 80521). J. Appl. Phys. 44: No. 8, 3394-3397 (Aug 1973).

The elastic properties of tantalum have been investigated over the temperature range 4.2–300 K. The values of the adiabatic elastic constants C_{11}, C_{44}, and $C_L = (1/2)(C_{11}+C_{12}+2C_{44})$ at 4.2 K in units of 10^{12} dyn/cm² are, respectively, 2.70, 0.873, and 3.02. The Debye temperature was calculated from the elastic constants and found to have the value of 265 K at low temperature. The elastic constants become temperature independent at low temperatures and approach linear behavior at high temperatures. In contrast to the normal behavior of the elastic constants, nuclear acoustic resonance experiments show anomalous line broadening. (auth)

30636 PHONON SPECTRUM OF THORIUM. Reese, R.A.; Sinha, S.K. (Ames Laboratory–U.S. Atomic Energy Commission and Department of Physics, Iowa State University, Ames, Iowa 50010); Peterson, D.T. Phys. Rev. B 8: No. 4, 1332-1337 (15 Aug 1973).

Inelastic-neutron-scattering measurements of the phonon dispersion relation in thorium at room temperature are reported. The measurements were made along the (0, 0, ζ), (0, ζ, ζ), (ζ, ζ, ζ), and (0, ζ, 1) symmetry directions. The dispersion curves are dominated by nearest-neighbor interactions but indicate a residual long-range interaction to at least seventh nearest neighbors. A seventh-neighbor force-constant model was fitted to the data and used to obtain a frequency distribution function and the temperature dependence of the Debye temperature. The transverse modes along the (0, ζ, ζ) direction appear to show structure indicative of strong electron–phonon interaction effects. (auth)

30637 ANALYSIS OF THE LATTICE SPECIFIC HEAT OF MO:RE ALLOY. Tiwari, M.D.; Agrawal, B.K. (Department of Physics, University of Allahabad, Allahabad 211002, India). Phys. Rev. B 8: No. 4, 1397-1401 (15 Aug 1973).

The low-temperature lattice specific heat of a Mo– 5-at.%–Re alloy has been successfully explained on the basis of a Green's-function theory. We take into account the effects due to change in mass at the substitutional impurity site and also the changes in the nearest-neighbor central and noncentral force constants for the impurity–host–crystal interaction. The enhanced specific heat is dominated by force-constant changes and very much sensitive to these changes. It is observed that the contribution of the even parity A_{1g}, E_g, F_{1g}, and F_{2g} modes are very significant and, in fact, dominate over that of F_{1u} symmetry modes in the low-temperature side of the specific-heat curve. However, at higher temperatures more resonance modes appearing in F_{1u} irreducible representation are excited and their contribution dominates over all others. The present values of the defect parameters are found to be quite similar to those obtained earlier by elastic-constant data. (auth)

30638 PHOTOELECTRON EMISSION AND THE D BANDS OF ZINC AND CADMIUM. Poole, R.T.; Leckey, R.C.G.; Jenkin, J.G.; Liesegang, J. (Physics Department, La Trobe University, Bundoora, Victoria, Australia 3083). Phys. Rev. B 8: No. 4, 1401-1406 (15 Aug 1973).

The d bands of Zn and Cd have been unambiguously located by photoelectron spectroscopy using 40.81-eV radiation. In Zn a single peak due to the $3d_{3/2,5/2}$ band of half-width 1.1 eV is found 9.5 eV below Fermi level, while for Cd, the $4d_{3/2,5/2}$ doublet is resolved at 10.2 and 11.1 eV below the Fermi level. The relevance of these results for band-structure calculations and for the interpretation of related optical and characteristic energy-loss experiments is discussed. (auth)

30639 DETERMINATION OF THE FERMI SURFACE OF MOLYBDENUM USING THE DE HAAS–VAN ALPHEN EFFECT. Hoekstra, J.A.; Stanford, J.L. (Ames Laboratory–USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. B 8: No. 4, 1416-1429 (15 Aug 1973).

The de Haas–van Alphen effect in molybdenum has been studied in detail using large impulsive magnetic fields. Digital data recording, fast Fourier–frequency analysis by computer, and dynamic calibration of the entire apparatus have been used to obtain the de Haas–van Alphen frequencies to a high degree of accuracy. Several new frequency branches associated with the electron–jack piece of the Fermi surface are reported. Frequency branches exhibiting high angular accuracy and resolution are reported for all branches that have previously been detected by other de Haas–van Alphen investigators. A quantitative description of all sheets of the Fermi surface is presented, along with comparisons with other Fermi-surface radii obtained by use of the radio-frequency–size-effect (RFSE) technique. The Mueller inversion technique for obtaining Fermi-surface radii from the de Haas–van Alphen area data was used whenever possible. The de Haas–van Alphen results presented are consistent with an estimate of 2.5% of the ΓH dimension for the size of the gap between the jack and the octahedral Fermi-surface pieces. Thus the question about the size of this gap as raised by discrepancies greater than the combined experimental errors existing in current RFSE data is resolved. The spin–orbit parameter is not found to be anomalously higher than that for tungsten. (auth)

30640 MOLYBDENUM: BAND STRUCTURE, FERMI SURFACE, AND SPIN–ORBIT INTERACTION. Iverson, R.J.; Hodges, L. (Ames Laboratory–USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. B 8: No. 4, 1429-1432 (15 Aug 1973).

The nonrelativistic energy bands of bcc Mo are calculated by the renormalized-atom method and the Fermi surface is obtained using an interpolated band structure. The de Haas–van Alphen data for the neck orbit of the electron jack and the electron lens are used to derive, for the crystal, a spin–orbit parameter of 0.0075 Ry, approximately equal to the atomic spin–orbit parameter. (auth)

Radiation Effects

Refer also to abstracts 30453, 31280, 31818, 31821, and 31860.

30641 (AAEC/LIB/BIB-370) FRACTURE BEHAVIOUR OF UNIRRADIATED AND IRRADIATED STEELS. A Bibliography, 1951–1972. Geue, P. J. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1972. 112p. Dep. NTIS (U.S. Sales Only) $7.75.

Four hundred forty-nine references are listed chronologically covering the period 1951–1972; references are limited to those of the Naval Research Labs., Washington, D.C. and associated authors. Reference is made to abstracts in different abstracting services where relevant. (AT)

30642 (AEC-tr-7478) SWELLING OF NICKEL IRRADIATED BY Ni^+ IONS OF AVERAGE ENERGY. Delaplace, J.; Azam, N.; Le Naour, L.; Lott, M.; Fiche, C. Translated from J. Nucl. Mater.: 47: 278-294(1973). 24p. Dep. NTIS $3.25.

After a brief summary of the advantages and drawbacks of bombardment with heavy ions, the experimental apparatus is described for studying swelling in nickel. Problems in determination of the number of atoms displaced during ion bombardment are discussed. The influence of the following parameters on the swelling of nickel were studied: temperature, gas content, fluence, and ion energy. Swelling varied with temperature and increases to a maximum at 620°C for 500-keV nickel ions. Prior helium loading of the samples (10 ppM) reduces swelling and the mean void size and increases the number of cavities. Swelling grows linearly with fluence up to 25 displacements per atom. The number and size of voids grows rapidly in the early stages of irradiation. It is explained how helium reduces swelling and it is shown how far the fluences calculated for ion bombardments need to be corrected to allow valid comparisons with in-pile results. (auth)

30643 (AEC-tr-7479) STUDY OF THE FORMATION OF CAVITIES IN COPPER IRRADIATED BY 500-keV COPPER IONS. Glowinski, L.; Fiche, C.; Lott, M. Translated from J. Nucl. Mater.: 47: 295-310(1973). 28p. Dep. NTIS $3.50.

The formation of voids in thin foils of copper irradiated by 500-keV Cu^+ ions was studied as a function of temperature, irradiation intensity, and dissolved gas content. A theoretical examination of the phenomena gives a good account of the effects of temperature, the rate of defect creation and the foil thickness, but it fails to account for the fact that at 400°C voids are formed for a dose of 3×10^{-4} dpa/s but not for 3×10^{-3} dpa/s. This is tentatively explained in terms of the influence of the gas content. The effect of gas content on the formation of voids and dislocation loops was moreover demonstrated by degassing thin foils by annealing in ultrahigh vacuum, or by implanting helium before irradiation. (auth)

30644 (CEA-CONF-2304) APPLICATION OF THE ION ANALYZER TO STUDIES OF HETERODIFFUSION IN METALS.

Beyeler, M.; Seran, J. L.; Blanchard, B.; Pichard, A.; Cligny, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires; Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires; Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). 1973. 33p. (In French). (CONF-730344-1). Dep. NTIS (U.S. Sales Only) $3.75.

From meeting of the national technical research association group No. 8B ion analyzer; Corbeville, France (16 Mar 1973).

The diffusion of metallic impurities in monocrystalline matrices of copper and aluminum irradiated with fast neutrons and ions was studied. Since the effects can extend over distances of several thousand angstroms, the ion analyzer technique was used. The experiments were carried out using diffusion couples prepared by evaporation or implantation at various temperatures and pressures. A comparison between these results and those provided by classical techniques indicates the possibility of using the ion analyzer to study defects. (France)

30645 (ORNL-4870, pp 10-14) ELECTRON MICROSCOPY. Stiegler, J. O. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Electron microscopy is being used to study microstructural changes, particularly in irradiated materials. Abstracts of published papers are given. (DLC)

30646 (ORNL-4870, pp 81-83) CONTROLLED THERMONUCLEAR RESEARCH. McHargue, C. J. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Tensile mechanical properties were obtained for samples of niobium, molybdenum, tantalum, and several of their alloys that had been irradiated in EBR-II at temperatures of 390 to 1140°C to neutron fluences of 1.5 to 1.6×10^{22} neutrons/cm^2 (>0.1 MeV). The effects of helium, injected with the ORIC, on the mechanical properties of Nb–1% Zr were determined. Creep tests were conducted at 1000, 1200, and 1400°C and results compared with undoped specimens. The variation of swelling with temperature was determined for pure aluminum, nickel, and vanadium irradiated in the ORR to 0.5 to 1.2×10^{21} neutrons/cm^2 (>0.1 MeV). These data form the basis for determining the temperature shift due to dose rate for ion bombardment experiments. An irradiation chamber was built for the ORNL 6-MV Van de Graaff, and ion sources were developed for self-ion and transmutation product irradiation. Corrosion data were reviewed to define the scope and nature of compatibility problems involving the first-wall metal and the lithium blanket. (auth)

30647 (RISO-M-1634) IRRADIATION EMBRITTLEMENT OF PRESSURE VESSEL STEELS. IAEA Research Agreement No. 1071/CF. Nielsen, A.; Westermann, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jul 1973. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

Several institutes in different countries agreed to irradiation experiments according to the approved program on steel A 533B from the American HSST program. Danish research on tensile, impact, and hardness properties of nonirradiated steel and steel irradiated at 290°C to 2×10^{19} n_f/cm^2 is summarized. (auth)

30648 (RISO-M-1641) EFFICIENCY OF VOID FORMATION DURING ANNEALING OF IRRADIATED MOLYBDENUM. Evans, J. H. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug 1973. 10p. Dep. NTIS (U.S. Sales Only) $3.00.

Results are presented to demonstrate the high efficiency of vacancy retention that occurs when voids are formed by the annealing at 900°C of molybdenum samples previously neutron irradiated at 60°C. In the particular case examined the efficiency is shown to be more than the theoretical maximum expected during the formation of voids under conventional high temperature neutron irradiation. Various aspects of this efficiency are discussed with particular reference to a recent positron annihilation study of the processes taking place during annealing. A mechanism for the high vacancy retention is suggested that depends largely on the storage of vacancies in loop form during irradiation below the temperature of vacancy loop shrinkage and the transfer of vacancies to voids on annealing above this temperature. There seems to be only a small possibility that the mechanism could operate unintentionally in reactor situations. On the other hand by ensuring void nucleation the high efficiency of void production by the irradiation-annealing method might be used to advantage in providing inexpensive void samples for experimental purposes. It is noticed that the behavior of the vacancy loops could provide a simple explanation of the empirical 0.3 T_m threshold for conventional void formation in metals. (auth)

30649 (RT/FI-(73)12) COMPARISON OF IONS AT DIFFERENT ENERGIES TO SIMULATE FAST-NEUTRON DAMAGE IN VOID FORMATION. Menzinger, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 17 Mar 1973. 31p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.75.

Measurements were carried out in order to compare ion accelerators of different energies to study void formation. Some materials previously studied under neutron irradiations were investigated with ions at much higher doses damage and their high resistance to voidage was confirmed. Ions investigated include Ni^+, Ni^{6+}, Cu^+, C^+, N^+, and O^+; materials: Ni, Ni–Cu, and Cu. (10 figures, 20 references) (auth)

30650 (ZJE-139) RADIATION HARDENING MECHANISM IN Fe–C–Mn TYPE ALLOYS. Brumovsky, M. (Skoda, Plzen (Czechoslovakia). Zavod Jaderne Elektrarny). 1973. 28p. Dep. NTIS (U.S. Sales Only) $3.50.

Radiation damage in Fe–C–Mn type alloys, chosen as a first approximation to low-carbon pressure-vessel steels, was studied after irradiation in two temperature regions (80 to 100°C and 160 to 180°C). Effect of saturation and "oversaturation" (expressed by softening) on yield strength value was confirmed. This effect depends on alloy structure and content of both alloy elements + carbon in the form of pearlite substantially increases the tendency to "oversaturation", while manganese shifts the saturation dose to higher values. For pure iron, a saturation dose equal to $\sim 4 \times 10^{19}$ n/cm^2 (E_n > 1 MeV) was found. At the same time, the presence of carbon results in the suppression of yield strength increase during irradiation while manganese enhances this yield strength increase if more than ~ 0.5 wt % Mn is present. On the basis of the analysis of individual parameter changes in the model of radiation hardening in Fe–C– Mn-type alloys, an explanation is proposed for the influence of neutron dose at irradiation temperatures of 80 to 100°C on the change in the tensile stress–strain curve, as well as the influence of carbon and manganese on the saturation and oversaturation effect. (8 figures, 14 references) (auth).

30651 ELASTIC BULK EFFECT IN NICKEL IRRADIATED BY ELECTRONS AT A VERY LOW TEMPERATURE. Soulie, J. C.; Lauzier, J.; Minier, C. (CEN, Grenoble, France). Radiat. Eff.; 19: No. 1, 63-64(May 1973). (In French).

The elastic bulk effect was measured during a 2-MeV electron irradiation of pure nickel at 18°K. A value $(\Delta M/M)/C = -70$ was obtained, where M is the elastic modulus and C is the concentration of Frenkel pairs created. (auth)

30652 BOMBARDMENT-INDUCED SURFACE DAMAGE IN A NICKEL SINGLE CRYSTAL OBSERVED BY ION SCATTERING AND LEED. Heiland, W.; Taglauer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Radiat. Eff.; 19: No. 1, 1-6(May 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

In an experiment which combines ion scattering at low energies and low energy electron diffraction (LEED) the influence of Ar^+ ion bombardment on the structure of a Ni(110) single crystal surface is investigated. At an energy of 1 keV, Ar^+ ion scattering from an undisturbed single crystal face is governed by multiple scattering, which can be described by sequences of binary collisions. Computer simulations of the scattering process show that, by introducing surface defects, changes in the backscattering spectra occur. The surface damage from the ion beam gives rise to increasing binary scattering, thereby decreasing multiple scattering. These changes are observable above 10^{15} ions/cm^2. The results suggest the production of point defects and extended defect structure. This is in qualitative agreement with the measurement of the widths of LEED spots, where the widths increase and become asymmetric with increasing dose. The production of point defects reaches saturation at 10^{16} ions/cm^2, at the dose rate applied. (auth)

30653 NONLINEAR VOLUME EXPANSION IN HELIUM-IMPLANTED ERBIUM METAL FILMS. Blewer, R. S.; Beezhold, W. (Sandia Labs., Albuquerque, NM). Radiat. Eff.; 19: No. 1, 49-52(May 1973).

Large dimensional expansion was observed at room temperature in erbium metal films implanted at room temperature with high fluences of helium. The interferometrically measured film thickness increases linearly with fluence up to a critical dose of 3×10^{17} He^+/cm^2 (E = 160 keV) and is superlinear at higher fluences. Annealing at 400°C causes a reduction of the induced expansion for fluences below the critical dose without apparent release of helium. Annealing of samples implanted to fluences greater than 3.5×10^{17} He^+/cm^2 causes accentuated expansion which is accomplished by formation and rupture of bubbles at the film surface. (auth)

30654 KINETICS OF DEFECT FORMATION IN ALKALI HALIDES AT HELIUM TEMPERATURES. Dienes, G. J. (Brookhaven National Lab., Upton, NY). J. Nonmetals; 1: No. 2, 165-171(Feb 1973).

The kinetics of defect formation in alkali metal halides at low temperature was investigated based on the following sequential steps: production of electrons and holes by ionizing radiation, self-trapping of holes to form V_K centers, recombination of V_K centers and electrons followed by a collision sequence to form F and H centers, ionization of F centers to form F^+ centers, and capture of electrons by the H centers to form I centers. The kinetic equations were solved by computer techniques for steady irradiation and for pulse irradiation. Analytic solutions were found for the steady-state approximation, valid after the decay of initial transients. During steady irradiation, once the transients have decayed, the total vacancy concentration (and the concentration of the other centers) increases linearly with irradiation time, in agreement with the available meager experimental data. A specific prediction of the kinetic scheme is the flux (dose rate) dependence of the above growth rate— linear in flux at low flux and gradually approaching flux independence at high flux. When the unstable nature of the close F–H pairs is explicitly taken into account, the response of the system to pulse irradiation simulates the experimental data, at least qualitatively. (auth)

30655 LOWER AND UPPER IRRADIATION TEMPERATURE LIMITS FOR VOID FORMATION IN METALS. Golubov, S. I.; Konobeev, Yu. V.; Subbotin, A. V. (Inst. of Physics and Power Engineering, Obninsk, USSR). Phys. Status Solidi (a); 18: No. 2, K81-K83(16 Aug 1973).

It is noted that, in metals irradiated using fast particles, the phenomenon of void formation is observed to occur in the limited irradiation temperature range 0.3 T_m to 0.55 T_m, where T_m is the melting temperature. An explanation of this temperature interval is given along with mathematical expressions for the change rates, activation energy for vacancy motion, and the condition of thermal instability of dislocation loops at the beginning of irradiation. (JRD)

30656 MOESSBAUER SPECTROSCOPY OF ^{57}Fe IMPLANTED INTO METALS. Sawicka, B. (Inst. of Nuclear Physics, Krakow); Sawicki, J.; Maydell-Ondrusz, E.; Lazarski, S. Phys. Status Solidi (a); 18: No. 2, K85-K89(16 Aug 1973).

Results of experiments involving implantation of $^{57}Fe^+$ ions in polycrystalline target foils of Al, Mg, Ti, Zn, Zr, Cd, Pt, and Au at 35 keV are presented. Data on target properties and Moessbauer spectra are presented tabularly and graphically and analyzed. (JRD)

30657 XENON-ION RANGES IN POLYCRYSTALLINE GOLD. Jokic, T. (Inst. of Nuclear Sciences, Belgrade). Phys. Status Solidi (a); 18: No. 2, K77-K80(16 Aug 1973).

Results of ^{133}Xe ion bombardment experiments to evaluate Xe ion ranges in Au are presented as integral depth distribution curves for Xe ions implanted in Au targets at 40 and 80 keV. The diagrams show monotonous decrease in radioactivity in the target with thickness. The maximum concentration for 80-keV ions is at a greater target depth than for 40-keV ions. All data are presented graphically. (JRD)

30658 XENON-ION RANGES IN COPPER SINGLE CRYSTALS. Jokic, T.; Perovic, B. (Inst. of Nuclear Sciences, Belgrade). Phys. Status Solidi (a); 18: No. 2, K73-K76(16 Aug 1973).

Results of experiments conducted to measure the range and depth distribution of ^{133}Xe ions in single-crystal Cu at 20 to 100 keV are presented. It was found that the ion ranges are strongly dependent on the penetration direction, being most pronounced in the ⟨110⟩ lattice direction. It was also found that the ion ranges are strongly dependent on bombarding energies. The depth of highest concentration of embedded Xe atoms is also energy dependent. (JRD)

30659 IRRADIATION SOFTENING IN PURE IRON SINGLE CRYSTALS. Sato, A.; Mifune, T.; Meshii, M. (Northwestern Univ., Evanston, IL). Phys. Status Solidi (a); 18: No. 2, 699-709 (16 Aug 1973).

The effect of electron irradiation on the plastic deformation of iron single crystals was investigated in the temperature range from 4.2 to 100°K. ZrH_2-purified iron single crystals were irradiated at an incident electron energy of 1.3 MeV at temperatures below 60°K. The electron irradiation was found to cause a "softening effect" on the purified iron. The temperature dependence and dose dependence of the softening effects were similar to those of the solid-solution softening effects. The results of the irradiation softening can be well described by the local double kink nucleation model presented in a previous calculation. On the basis of the study, it is suggested that the mechanism causing the irradiation softening of iron is similar to the mechanism controlling the solid-solution softening. (auth)

30660 INFLUENCE OF DISLOCATIONS ON NEUTRON-IRRADIATION DAMAGE IN MOLYBDENUM. Cornelis, J. (Katholic Univ., Louvain, Belgium); De Mecster, P.; Stals, L.; Nihoul, J. Phys. Status Solidi (a); 18: No. 2, 515-522(16 Aug 1973).

The influence of various populations of cold-work defect structures following heavy plastic deformation on the defect production during neutron irradiation of molybdenum at 330°K and on the annealing spectrum up to 1200°K has been investigated. It is observed that the presence of dislocations considerably enhances the defect retention. The annealing of this supplementary radiation damage is about equally distributed over the whole recovery spectrum. Based on results of radiation annealing of cold work stage III defects an upper limit can be deduced for the mean diameter $\bar{d}$ of the displacement cascade as being equal to 40 lattice distances, which, in view of previous results, yields for $\bar{d}$: 151.d. < $\bar{d}$ < 401.d. The defect production plotted as a function of the preirradiation annealing temperature yields a maximum, which can largely be accounted for by the radiation-annealing of cold-work stage III defects. (auth)

30661 SUPPRESSION OF VOID NUCLEATION BY OVERSIZED SOLUTE ATOMS. Kuhlmann-Wilsdorf, D. (Univ. of Virginia, Charlottesville). Scr. Met.; 7: No. 10, 1059-1063(Oct 1973).

The interaction between vacancies and internal stress in metals is discussed from the standpoint of the theory which considers it to be made up of four components. The interaction energy is interpreted in terms of a binding energy for fcc metals, and its magnitude is shown for edge and screw dislocations. The distribution of the equilibrium vacancy concentration about an edge dislocation is also given. The most compressed part of the dislocation core repels vacancies. Excess vacancies will occur in the dilated parts of the dislocation cores, and interstitials are attracted to the dilated parts. Thus, edge dislocations are efficient sinks for interstitials and inefficient sinks for vacancies. Preferential elimination of interstitials at dislocations is shown to be a necessary condition, but not a sufficient condition, for void formation in fcc metals. The experimental observations of nucleation of voids and loops close to, but not on dislocations, support the theory. Addition of oversized solute atoms or use of nonstoichiometric alloys with high vacancy contents should suppress void formation. (DLC)

30662 COMMENTS ON THE SUPPRESSION OF VOID NUCLEATION BY OVERSIZE SOLUTE ATOMS. Smidt, F. A. Jr.; Sprague, J. A. (Naval Research Lab., Washington, DC). Scr. Met.; 7: No. 10, 1065-1068(Oct 1973).

Reference is made to the model of Kuhlmann-Wilsdorf (see preceding abstract) in which edge dislocations are predicted to be efficient sinks for interstitials but inefficient sinks for vacancies. It is pointed out that the model ignores evidence to the contrary, and that vacancy trapping is not ruled out. It is concluded that while oversize solute atoms may influence void nucleation, the Kuhlmann-Wilsdorf model overlooks several important factors. (DLC)

30663 OPTICAL ABSORPTION SPECTRA OF N-TYPE GAAS IRRADIATED WITH LARGE ELECTRON DOSES. Brailovskii, E.Y.; Brudnyi, V.N.; Krivov, M.A.; Red'ko, V.B. (V. D. Kuznetsov Siberian Physicotechnical Institute, Tomsk). Sov. Phys.-Semicond. 6: No. 10, 1768-1769 (Apr 1973).

30664 THEORY OF GIANT TRANSMISSION ELECTRON SPIN RESONANCE IN ION-IMPLANTED FILMS. Walker, M.B. (Department of Physics and Scarborough College, University of Toronto, Toronto, Ontario M5S 1A7, Canada). Phys. Rev. Lett. 30: No. 19, 891-894 (7 May 1973).

A theoretical model is proposed which gives a qualitative explanation of the dominant features of the recent experiments of Monod, Hurdequint, Janossy, Obert, and Chaumount. In particular, the origin of the large enhancement factors is explained, and the spectrum observed in the implanted alloys is related to the spectra observed in the pure metal and in a homogeneous magnetic alloy similar to the implanted layer. (auth)

30665 FATIGUE-CRACK PROPAGATION IN FAST-NEUTRON-IRRADIATED TYPES-304 AND -316 STAINLESS STEELS. James, L. A.; Knecht, R. L. (Westinghouse Hanford Co., Richland, WA). Contract AT(45-1)-2170. Nucl. Technol.; 19: No. 3, 148-155(Sep 1973).

The post-irradiation fatigue-crack propagation behavior of solution-annealed Type-304 and 20% cold-worked Type-316 stainless steels irradiated to a fluence of 1.3×10^{21} n/cm^2 (E > 0.1 MeV) at temperatures of ~851 and 891°F was characterized using linear elastic fracture-mechanics techniques.

Irradiation to this fluence had little or no effect on the crack-growth behavior of both materials at test temperatures of 800 and 1000°F. (auth)

30666 BLISTERING IN HELIUM-ION-IMPLANTED (111) NIOBIUM MONOCRYSTALS. Das, S.K.; Kaminsky, M. (Argonne National Laboratory, Argonne, Illinois 60439). J. Appl. Phys. 44: No. 6, 2520-2529 (June 1973).

The formation of helium blisters on the (111) surface planes of monocrystalline niobium by implantation of 0.5–1.5-MeV helium ions has been investigated for total doses ranging from 0.1 to 1.0 C/cm^2 for different target temperatures, angles of incidence of the projectiles, and channeling conditions. The results indicate that the blister shape is strongly dependent on target temperature. At 900 °C and for channeled projectiles, almost all the blisters have a threefold symmetry resembling a "crow-foot" shape. The alignment of the crow-foot blisters with respect to each other exhibits an asymmetry in that their prongs are aligned along only one set of <112> directions of the host niobium lattice such as [12$\bar{1}$], [11$\bar{2}$], and [$\bar{2}$11] directions and not along the other equivalent set such as the [$\bar{1}$21], [$\bar{1}\bar{1}$2], and [2$\bar{1}\bar{1}$] directions. As the target temprature is lowered, the tendency to form dome-shaped blisters increases; at room temperature only dome-shaped blisters form. The average blister size appears to increase with decreasing target temperature, with increasing degreee of channeling, and with increasing projectile energy; at room temperature the last of these variables is the one with the most pronounced effect on the size. The blister density is more than two orders of magnitude less for channeled projectiles than for unchanneled ones for irradiation at a target temperature of 900 °C. For the unchanneled projectiles, the angle of incidence of the projectiles does not appear to change the morphology of the blisters significantly. (auth)

Other Materials

Refer also to abstracts 29675, 29683, 30453, 30490, 30589, 32141, 32144, 32145, 32149, 32193, 32195, 32197, and 32205.

30667 (ORNL-4870, pp 15-16) FUNDAMENTAL CERAMICS RESEARCH. Smith, G. P.; Brynestad, J. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

The only unpublished data given are on the anisotropic optical absorption bands of deformed CaF_2. (DLC)

30668 (ORNL-4870, pp 87-90) BIOMATERIALS. Adamson, G. M. Jr. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

A type 316L stainless steel Jewett nail and plate that failed after only three weeks service in the femur of a 21-year-old soldier was metallographically examined. Failure initiated in a microscopic groove introduced in a critical area of stress during insertion of the nail. Stress-corrosion cracking and intergranular corrosion played an active role in the fracture of the implant. Graphite is known to be highly compatible with the human body, and recently developed experimental graphites possess mechanical properties commensurate with living bone. Currently, graphites are being further developed with a pore texture to permit penetration by the living bone, thus providing a self-locking attachment between a prosthetic device and the bone. Preliminary tests carried out in rabbits at the University of Illinois have shown complete biological and mechanical compatibility. (auth)

30669 (ORNL-4870, pp 91-92) GRAPHITE FABRICATION STUDIES FOR NAVAL ORDNANCE LABORATORY. Kennedy, C. R.; Eatherly, W. P. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

The program for development of a missile-nose-tip graphite with superior thermal shock and ablation resistance is continuing. During the past year successful techniques were developed to fabricate bulk graphites from acicular green cokes. Preliminary tests indicate the shock resistance of these materials is at least double that of currently used graphites. (auth)

30670 EFFECTS OF ROOM TEMPERATURE ANNEALING ON THE LUMINESCENCE OF ELECTRON-IRRADIATED ZnS. Shono, Y.; Yoshida, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 76-78(1972).

The effects of room-temperature annealing on the intensity of the luminescence observed in electron-irradiated ZnS crystal were studied. The luminescence intensity increased as a whole after the electron-irradiated ZnS crystal was kept at room temperature and decreased by annealing at higher temperatures. Two processes are proposed to explain the increase in the luminescence intensity caused by room-temperature annealing. One is the process that the defects introduced by electron irradiation associate with native imperfections and become trapping centers. In the other, the defects associate with some radiationless recombination centers, resulting in a decrease of the number of radiationless recombination centers. In either process, migration at room temperature of the defects is essential. (auth)

30671 PHOTOCONDUCTIVITY EXCITATION AND QUENCHING SPECTRA OF ELECTRON-IRRADIATED CdS SINGLE CRYSTALS IN AN INFRARED REGION. Yoshida, T.; Oka, T.; Kitagawa, M.; Fujino, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 65-72(1972).

Photoconductivity excitation and quenching spectra of CdS single crystals irradiated with 10-MeV electrons were studied. Monochromatic light chopped doubly with frequencies of 13 and 150 Hz and lock-in amplifier systems were used. Measurement was made at various temperatures from liquid nitrogen temperature to room temperature under illumination with bias light of 0.53 μ at different intensities. Found are excitation bands around 0.93, 1.1, and 1.7 μ produced by irradiation, and quenching bands around 0.76, 0.9, 1.2, and 1.4 μ. The quenching band around 1.2 μ seems to be sensitive to irradiation. The excitation bands decrease in magnitude at high temperatures. (auth)

30672 PbTe PHOTODIODES FABRICATED BY Sb^+ ION IMPLANTATION. Donnelly, J. P.; Harman, T. C.; Foyt, A. G.; Lindley, W. T. (Massachusetts Inst. of Tech., Lexington). J. Nonmetals; 1: No. 2, 123-128(Feb 1973).

From conference on the physics of 4-6 compounds and alloys; Philadelphia, Pennsylvania (24 Mar 1972).

Planar n-p junction photodiodes in PbTe were fabricated using Sb^+ ion implantations. At 77°K, 15-mil-square diodes have had zero-bias resistances as high as 15 M Ω for a resistance-area product of 2.1×10^4 Ω-cm^2. Peak detectivities at 4.4 μm in reduced background were measured. Diode quantum efficiencies without antireflection coatings were typically 40% at 4.4 μm. The forward current–voltage characteristics of these diodes exhibit an exponential type behavior [$I \propto \exp(qV/nkT)$] where $n \approx 1.6$, while the reverse characteristics exhibit a linear type behavior followed by a soft power law-type breakdown ($I \propto V^n$). The capacitance–voltage measurements indicate a linearly graded junction. (auth)

30673 INFLUENCE OF FLAW DENSITY AND FLAW SIZE DISTRIBUTION ON THE STATIC AND DYNAMIC FATIGUE BEHAVIOUR OF GRAPHITE. Wilkins, B. J. S.; Jones, B. F. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). J. Mater. Sci.; 8: No. 9, 1362-1364(Sep 1973).

Experimental data concerning the fatigue behaviour of graphite have previously been examined statistically. Further consideration has now been given to the effects of flaw density and flaw size distribution on fatigue behaviour. The experimental data are compared with the results expected in the case of an imaginary material containing a single flaw. (UK)

30674 PRESSURE DEPENDENCE OF C-AXIS ELASTIC PARAMETERS OF ORIENTED GRAPHITE. Green, J. F.; Bolsaitis, P.; Spain, I. L. (Univ. of Maryland, College Park). J. Phys. Chem. Solids; 34: No. 11, 1927-1937(Nov 1973).

The elastic c-axis moduli C_{33} and C_{44} of compression-annealed pyrolytic graphite and their derivatives with hydrostatic pressure were measured at room temperature over a pressure range from 1 to 7000 bars (700 MNm^{-2}) using an ultrasonic pulse-echo technique. The experiments were also made with material irradiated with fast neutrons. The pressure dependence of the c-axis compressibility of these materials was calculated from the experimental data, enabling pressure derivatives of the c-axis moduli to be also expressed as c-axis strain derivatives. (auth)

30675 INTERACTION OF RADIATION WITH MATTER, PARTICULARLY SEMICONDUCTORS. Zander, K. (Verband Deutscher Elektrotechniker (VDE) eV, Frankfurt am Main). NTZ Nachrtech. Z.; 26: No. 7, 305-311(1973). (In German).

The application of semiconductor construction elements (HBE) in the neighborhood of reactors and accelerators, as well as in space, arouses a vast interest in the radiation-induced behavior of semiconductors and of HBE. A large number of experiments and publications regarding analysis and diagnosis of radiation damage soon lead to certain corrective measures. A survey on the physical and chemical effects of various radiation on semiconductor materials is given. The report concludes with comments on the radiation loaded use of HBE. (GE)

30676 F-CENTER PRODUCTION IN UNDOPED CaF_2 CRYSTALS BY NEUTRON IRRADIATION AT LOW TEMPERATURE. Okada, M.; Atobe, K.; Nakagawa, M. (Kyoto Univ.). Radiat. Eff.; 19: No. 1, 65-66(May 1973).

F centers were induced in undoped CaF_2 crystals irradiated by neutrons at 18°K. Optical-absorption bands were recorded

after annealing at temperatures from 77 to 310°K. All spectra were recorded at 77°K. Results were compared with those published by other authors. It is concluded that the F centers are produced by irradiation by reactor neutrons at low temperatures (~18°K). The F and self-trapped (300 nm V_H band) centers are always produced in pairs. Results show that fluorine atoms are displaced effectively by the incident high-energy neutrons (or electrons) from a lattice site to an interstitial site. (UK)

30677 MODEL CORRECTION FOR THE FORMATION OF AMORPHOUS SILICON BY ION IMPLANTATION. Dennis, J. R.; Hale, E. B. (Univ. of Missouri, Rolla). Radiat. Eff.; 19: No. 1, 67-68(May 1973).

The critical dose at which an implanted amorphous layer in silicon is formed cannot be explained by a previous energy-independent model (Morehead et al., Rad. Effects; 6: 27 (1970)). An energy-dependent correction to this model can explain the ESR data as well as other data. The correction is most important for light ions. (auth)

30678 UV ABSORPTION IN X-RAYED TRIGLYCINE SULFATE AND ITS TEMPERATURE DEPENDENCE. Zerem, J.; Chang, H.; Halperin, A. (Hebrew Univ., Jerusalem). J. Nonmetals; 1: No. 2, 97-101(Feb 1973).

The uv absorption induced in TGS by x irradiation at room temperature does not appear when the irradiation takes place at 77°K. Subsequent annealing of the irradiated crystal at temperatures above 200°K causes the uv absorption to appear. As a function of the annealing temperature, the absorption grows in steps at 200, 300, and 370°K with activation energies of about 0.3, 0.5, and 0.8 eV respectively. The absorption band itself is composed of three components at 255, 290, and 360 nm. The absorption bands can be bleached optically at 77°K. Selective bleaching of the various components can also be obtained by illumination with wavelengths within the given component. Warming of the bleached crystal causes the uv absorption to appear again. Results are discussed and a model is given to explain the observations. (auth)

30679 EFFECT OF REACTOR IRRADIATION ON THE DIELECTRIC LOSS PEAKS OF NYLON AND MYLAR. Valkiainen, M.; Tiainen, O. J. A.; Suntola, T. (Valtion Teknillinen Tutkimuskeskus, Helsinki). Radiat. Eff.; 19: No. 1, 61-62(May 1973).

The effect of irradiation on the dielectric properties of nylon 66.6 and Mylar was studied. In the case of nylon, the dielectric loss peak at 350°K measured with an angular frequency of 10^4 l/s disappeared due to irradiation and the peak at higher temperatures shifted to still higher temperatures. In Mylar, the α-peak grew in magnitude, indicating an increase in amorphousness, while the β-peak decreased. A rough estimate for the decrease in the magnitude of the effective number of dipoles is presented. The irradiation was carried out up to fast neutron fluence of 3×10^{17} nvt and gamma dose of 1×10^9 rad. (UK)

30680 THERMOLUMINESCENCE SPECTRUM OF HEAVILY-IRRADIATED LiF(TLD-100). Jain, V. K.; Bapat, V. N.; Kathuria, S. P. (Bhabha Atomic Research Centre, Bombay). J. Phys., C (London); 6: No. 17, L343-L344(4 Sep 1973).

The thermoluminescence spectrum of LiF was observed after heavy γ irradiation. Unlike the spectra reported in the literature, this is found to extend to the red region and contain peaks at 330 nm, 348 nm, 436 nm and 635 nm. (auth)

30681 SWITCHING EFFECT IN β-RHOMBOHEDRAL BORON. Prudenziati, M.; Lanzi, A.; Majni, G.; Malavasi, G. (Univ., Modena, Italy). Phys. Status Solidi (a); 18: No. 2, 651-659(16 Aug 1973).

Switching effects have been studied in high-resistivity undoped β-rhombohedral boron in the temperature range 77 to 400°K using electrical and electro-optical measurements. The data collected must be interpreted using different models describing the origin of the switching action, i.e., double injection at low temperatures (about 77 to 250°K) and thermal instability at higher temperatures (250 to 400°K). A description of the main physical events giving rise to switching for double injection in the investigated sample is given. Emission of infrared radiation in the post-switching regime due to hole–electron recombination is also reported. (auth)

30682 INDUCED F-AGGREGATE CENTERS IN NaF CRYSTALS IRRADIATED WITH CHARGED PARTICLE AT LOW TEMPERATURE. Kikuchi, A.; Ozawa, K. (Japan Atomic Energy Research Inst., Tokai). Phys. Status Solidi (a); 18: No. 2, 567-578(16 Aug 1973).

NaF crystals were irradiated at LNT with protons and deuterons in the energies of 1.5 and 1.7 MeV, which include the nuclear resonant reactions, $^{19}F(p,\alpha\gamma)^{16}O$ and $^{19}F(d,\alpha\gamma)^{17}O$. Thermal aggregation and annihilation of the radiation-induced defects were investigated using the optical absorption spectrum in warming and isochronal pulse-annealing experiments. Four prominent absorption bands were observed at 460, 570, 632, and 870 nm during warming in the absence of the R bands, measured at LNT. The 460-nm band, not observed in crystals irradiated at room temperature, is suggested to be due to a transition of R-type centers substituted in an O_2^- molecule ion for one of their halogen ion sites; the pair of bands at 570 and 632 nm, also supposed to contain an O_2^- ion in their lattice sites, is attributed to the R_N centers; the 870 nm band is identified as arising from the R′ centers. The processes of the formation of these bands are considered briefly. The R_1 and R_2 bands make their first appearance on annealing at temperatures between 370 and 390°K. At the same time the R_N bands are bleached and converted to the 575- and 623-nm bands, which are assigned to the transitions of the N_1 and N_2 centers, respectively. The N bands, when annealed around 400°K, are split into several absorption bands with vibrational structures, their components being tentatively assorted by their zero-phonon lines. Above 400°K, the 460 nm band is replaced by the colloids. (auth)

30683 INFLUENCE OF X IRRADIATION ON A PHASE TRANSITION IN CsCl THIN FILMS. Forier, R. P.; Hiernaut, J. P.; van Cakenberghe, J. (Universite de l'Etat, Mons, Belgium). Phys. Status Solidi (a); 18: No. 2, K69-K72(16 Aug 1973).

Experimental results are presented showing that x-irradiation introduces damage in CsCl that can be detected by its effect on a phase transition. The displaced atoms resulting from the irradiation are more effective than impurities in hampering the phase transition. This effect disappears after annealing. (JRD)

30684 INFLUENCE OF CREEP STRAIN ON THE ELASTIC MODULUS, CRYSTALLOGRAPHIC ORIENTATION AND DENSITY OF A POCO GRAPHITE. Zukas, E. G.; O'Rourke, J. A.; Armstrong, P. E.; Green, W. V. (Los Alamos Scientific Lab., NM). Carbon; 11: No. 4, 317-321(Aug 1973).

POCO HPD-1 graphite is a very fine-grained, high-density, nearly isotropic graphite. However, it becomes less isotropic and less dense during high-temperature creep deformation. Changes in crystallographic orientation, density, and modulus were measured as functions of creep strain. The modulus changes induced by creep seem to be related to the orientation and density changes. Modulus values were intermediate between calculated values based on the constant-stress model and those based on the constant-strain model. (auth)

30685 THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF POCO GRADE AXF-Q1 GRAPHITE TO 3300°K. Bapat, S. G. (Southern Research Inst., Birmingham, AL); Nickel, H. Carbon; 11: No. 4, 323-327(Aug 1973).

Data on thermal conductivity and electrical resistivity of Poco Grade AXF-Q1 graphite are presented for the interval 110 to 3300°K. The temperature range was covered by two steady-state techniques: a comparative rod apparatus and a radial inflow apparatus. Above 500°K the thermal conductivity data are represented quite well by a T^{-1} type function that is characteristic of Umklapp scattering processes which give rise to the thermal resistivity. It is also shown that the lattice conduction accounts for about 80% of the heat transport even at 3300°K. For more highly graphitized graphite and other cokes, the results can be different. The results are at variance with some that indicate a strongly decreasing thermal conductivity above 3000°K or a constant thermal conductivity with a strong electronic conduction at up to 3300°K. (auth)

30686 ANOMALOUS BEHAVIOR OF THE ELECTRICAL RESISTANCE AND OPTICAL ABSORPTION OF β BORON. Anisimov, B. B.; Dzhamagidze, S. Z.; Shvangiradze, R. R. (Sukhumi Physicotechnical Institute). Sov. Phys.-Semicond.; 6: No. 11, 1873-1874(May 1973).

In earlier papers the authors reported that near 300°C the majority of β-rhombohedral boron samples exhibited anomalies in the temperature dependences of the electrical resistance, the temperature coefficient of the forbidden-band width, the optical absorption, and the interplanar distances along certain crystallographic directions. Results are presented here on the correlation between the optical and electrical anomalies of β boron after measuring simultaneously the temperature dependences of the optical absorption coefficient beyond the fundamental edge ($\lambda = 1.54\ \mu$) and the electrical resistance of samples quenched in liquid nitrogen from temperatures exceeding that at which anomalies were observed. (auth)

30687 EFFECTS OF THE BOND-BENDING COEFFICIENT ON THE THERMAL EXPANSION COEFFICIENT OF GRAPHITE PARALLEL TO THE HEXAGONAL AXIS. Kelly, B. T. (United Kingdom Atomic Energy Authority, Springfields, Eng.). Carbon; 11: No. 4, 379-381(Aug 1973).

The hexagonal axis thermal expansion coefficient of a graphite crystal is calculated up to 1000°K using the measured values of two of the three anharmonic coefficients which affect the out-of-plane acoustic vibrational mode. The third anharmonic coefficient ($\partial\delta/\partial e_m$), which is determined by changes in the bond-bending constant of a layer plane with interlayer spacing, is shown to lie in the range 0 to -0.50×10^{-3}cm²/sec. (auth)

30688 WATER VAPOR PERMEABILITY OF POLY(VINYL ALCOHOL) FILMS MODIFIED BY GRAFT POLYMERIZATION OF STYRENE BY MEANS OF IRRADIATION. Yoshitake, T. (Kuraray Co., Ltd., Okayama, Japan). Nippon Kagaku Kaishi; 1973: No. 6, 1244-1246(Jun 1973). (In Japanese).

Water vapor permeability of poly(vinyl alcohol) (PVA) films modified by radioinduced graft polymerization was measured. Water vapor permeability of PVA film was decreased by the grafting of styrene. Water vapor permeability of films whose graft percentage was greater than 400% was approximately equal to that of polystyrene film. On the basis of the water vapor permeability data, decrease in water vapor permeability was found less effective in PVA films modified by graft polymerization of styrene than in laminated films of PVA and polystyrene. (auth)

30689 CONSTANT-STRESS IRRADIATION-INDUCED COMPRESSIVE CREEP OF GRAPHITE AT HIGH FLUENCES. Gray, W. J. (Battelle Pacific Northwest Labs., Richland, WA). Carbon; 11: No. 4, 383-392(Aug 1973).

One needle coke graphite and two isotropic graphites were irradiated under compressive stresses of 1000, 2000, and 3000 psi at 550 and 800°C to 1.1×10^{21}n/cm². At 550°C, the creep is linear with fluence and occurs at approximately constant volume for all three graphites. At 800°C, the creep is linear with fluence initially, but at 2000 and 3000 psi for the two isotropic graphites, the creep decreases markedly and even becomes negative at the highest fluences. Creep occurs with a small-volume decrease at 800°C for all three graphites. (auth)

30690 NONLINEAR MECHANISMS FOR RADIATION-INDUCED THERMALLY ACTIVATED DEPOLARIZATION PHENOMENA. Moran, P. R.; Podgorsak, E. B. (Univ. of Wisconsin, Madison). Phys. Lett.; 44A: No. 4, 237-238(18 Jun 1973).

A transient thermally stimulated charge transport, as described solely by a field-independent conductivity, cannot produce the strong RITAD effects observed in many ionic solids. (auth)

30691 ANISOTROPY OF THE THRESHOLD ENERGY OF FORMATION OF PRIMARY RADIATION DEFECTS IN SILICON. Baranov, A. I.; Panov, V. I.; Smirnov, L. S.; Sokolov, S. A. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys. Semicond.; 6: No. 11, 1920-1921(May 1973).

Earlier experiments involving measurements of changes of electrical properties of crystals as a result of irradiation with fast electrons failed to reveal the anisotropy of the threshold energy. Observations of the anisotropy in Si are described here for threshold energies of 215, 238, and 255 keV along the [111], [100], and [110] crystallographic directions, respectively; also, an analytic description of this anisotropy is given, based on the experimental results obtained and on the symmetry of the diamond lattice. (LMT)

30692 CARRIER-GENERATION LEVELS IN SILICON P-N JUNCTIONS IRRADIATED WITH ACCELERATED BORON IONS. Yudin, V.V.; Karatsyuba, A.P. Sov. Phys.-Semicond. 6: No. 11, 1932-1933 (May 1973).

Planar p–n junctions of diameter 2 mm were formed in n-type Si by implantation of 10-keV B ions (total dose 3.1×10^{15} cm^{-2}). Gettering treatment was then carried out at 900°C, applied for 10 min; depth of the junctions was 0.25 ± 0.02 μ. The junctions were next irradiated with 40- and 100-keV B ions and annealed in 1×10^{-5} torr vacuum and in a stream of Ar at 900 and 1000°C. The reverse current was measured under a voltage of 10 V. Results discussed include: (1) dependences of the reverse current on the annealing temperature; (2) positions of the carrier-generation levels in the forbidden band as determined from the temperature dependences of the reverse current; and (3) positions of the carrier-generation levels as a function of the energy of the implanted ions. (LMT)

30693 INFLUENCE OF FAST-ELECTRON IRRADIATION ON THE STATE OF IRON ATOMS PRECIPITATED ON DISLOCATIONS IN SILICON. Zolotukhin, A.A.; Milevskii, L.S. (A. A. Baikov Institute of Metallurgy, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Semicond. 6: No. 11, 1886-1887 (May 1973).

The first experimental results are reported on the influence of irradiation on the state of iron atoms in silicon precipitated from the solid-solution state onto dislocations. The effectiveness of the influence of 2.2-MeV electrons on the iron atoms in Cottrell atmospheres was increased by raising the density of the dislocations in Si crystals up to ~10^6 cm^{-2} and then saturating these crystals with iron by a heat treatment lasting 30 min at 1200°C. Results showed that irradiation removed some of the iron atoms in Si from the Cottrell clouds and produced a substitutional solid solution. (LMT)

30694 INFLUENCE OF THE NEUTRON SPECTRUM ON THE RADIATION CONSTANT OF THE CARRIER LIFETIME IN SILICON. Afanas'ev, V.N.; Zysin, Y.A.; Stepovik, A.P.; Tuturov, Y.F. Sov. Phys.-Semicond. 6: No. 11, 1866-1867 (May 1973).

An investigation was made of the influence of the neutron spectrum on the radiation constant of the carrier lifetime, which was deduced from the transient characteristics of silicon diodes. It was found that at 290°K the radiation constants ranged from $(1.2 \pm 0.3) \times 10^6$ nsec/cm² for a source of 14 MeV neutrons to $(9.6 \pm 2.0) \times 10^6$ nsec/cm² for reactor neutrons of 0.52 MeV energy. At 77°K these radiation constants decreased by about an order of magnitude compared with the values at room temperature, but their ratio remained approximately the same. These results were in agreement with the calculated ratios of the number of defects generated by identical fluxes of neutrons of different energies. (auth)

30695 INTERACTION OF DEFECTS AND IMPURITIES IN SILICON CONTAINING IMPLANTED IONS. Gerasimenko, N.N.; Dvurechenskii, A.V.; Romanov, S.I.; Smirnov, L.S. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Govosibirsk). Sov. Phys.-Semicond. 6: No. 10, 1692-1694 (Apr 1973).

The ESR method and the diffraction of reflected fast electrons were used to study the interaction between defects generated by ion bombardment and impurities introduced by diffusion or ion implantation. It was found that paramagnetic defects (VV centers) disappeared at a certain concentration of the implanted boron and phosphorus atoms. Further bombardment of a nonparamagnetic amorphous layer restored the original crystal structure and the restored regions had fewer defects when P^+ ions were used. This effect was not observed when silicon was bombarded with Ar^+ ions. (auth)

30696 RADIATION-STIMULATED FORMATION OF COMPLEXES IN P-TYPE INDIUM ANTIMONIDE. Vitovskii, N.A.; Vikhlii, G.A.; Mashovets, T.V. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.-Semicond. 6: No. 10, 1703-1707 (Apr 1973).

Indium antimonide doped with germanium or iron was irradiated at low temperatures with x rays of 250 keV maximum energy. This irradiation reduced the concentrations of shallow acceptors and donors, raised the mobility in the impurity scattering region, and increased the activation energy of the shallow acceptors, which tended to a value ϵ_1 typical of isolated impurity centers. The results could be explained on the hypothesis of radiation-stimulated migration of impurities accompanied by the formation of neutral acceptro—donor complexes. (auth)

30697 ELECTRON RADIATION DAMAGE AND ANNEALING OF $HG_{1-X}CD_XTE$ AT LOW TEMPERATURES. Melngailis, J.; Ryan, J.L.; Harman, T.C. (Massachusetts Institute of Technology, Lincoln Laboratory, Lexington, Massachusetts 02173). J. Appl. Phys. 44: No. 6, 2647-2651 (June 1973).

Samples of $Hg_{1-x}Cd_xTe$ with $x=0.22$ and $x=0.31$ have been irradiated with dosages of up to 4.7×10^{15} electrons/cm² of 2.5-MeV electrons. During the irradiation the sample temperature was below 25 °K. The samples were initally p type, i.e., at 77 °K the hole carrier concentrations were in the range $(2.5–4.3) \times 10^{16}$cm^{-3}. After irradiation all samples were found to be n type. A dose of 4.7×10^{15} electrons/cm² yielded an electron carrier concentration of 1.5×10^{17} cm^{-3} at 8 °K and an electrical conductivity σ four orders of magnitude larger than the unirradiated σ at 8 °K. The electron Hall mobility for low dosages and small measured electron concentrations is very low (500–2500 cm²/V sec). As the dosage is increased, the mobility rises rapidly and then saturates. Postirradiation annealing results in almost complete restoration of the transport properties. Much of the annealing occurs between 50 and 75 °K. The luminescence and photovoltaic response (at 8 °K) of the $x=0.31$ samples were measured before irradiation, after irradiation, and at several stages of the annealing. The irradiation shifts the luminescence and the photovoltaic response cutoffs to lower energies. Most of this change in optical properties anneals out between 100 and 250 °K. (auth)

30698 MAGNESIUM-25 HYPERFINE CONFIRMATION OF THE LOCALIZED-GROUND-STATE MODEL OF THE V^- CENTER IN MGO. Halliburton, L.E.; Cowan, D.L. (Department of Physics, University of Missouri, Columbia, Missouri 65201); Blake, W.B.J.; Wertz, J.E. Phys. Rev. B 8: No. 4, 1610-1616 (15 Aug 1973).

The localized-hole model of the V^- center in the alkaline earth oxides is represented as a positive hole trapped on one oxygen atom adjacent to a positive-ion vacancy (in the ground state and on the time scale of an ESR experiment). Upon trapping the hole, the oxygen atom is

presumed to relax away from the vacancy, thus lowering the symmetry from octahedral to tetragonal. The validity of this model has recently been challenged on the basis that a proper description of the ground state is a molecular orbital representing a linear combination of states with the hole on either of the two oxygen atoms opposite one another about the vacancy. We present the analysis of some ESR spectra in which we observed the resolved hyperfine splitting due to a single $^{25}Mg^{2+}$ ion adjacent to the trapped hole and on the axis of the defect. From the natural abundance of the ^{25}Mg isotope one can calculate the expected hyperfine line intensities relative to that of the central line arising from V^- centers having only ^{24}Mg or ^{26}Mg atoms in the axial positions, for the localized and for the delocalized models. The measured relative intensities agree with those calculated for the localized model. An analysis of the axial spectrum indicates the presence of an unusually intense forbidden line at X band. This becomes relatively more intense at the Ku band, as expected. Shifts of line position and intensity relative to the lines of an allowed hyperfine sextet agree with those predicted. The values of the hyperfine parameters are found to be $A=+2.84$ MHz and $B=-0.86$ MHz. The quadrupole parameter is found to be $+0.18$ MHz. The sign of A is anomalous in that a contact interaction is expected to give an isotropic parameter with the sign of the nuclear magnetic moment. This may result from exchange polarization. The magnitude of B is interpreted as indicating a compact unpaired charge distribution. The V^- centers studied here were generated by fast-neutron irradiation, and there is no confusion with impurity-associated hole centers; the former have a long-term stability in MgO, while the latter decay rapidly to negligible levels at room temperature. (auth)

30699 ENHANCEMENT OF IMPURITY-ION ABSORPTION DUE TO RADIATION-PRODUCED DEFECTS. Yun, S.I.; Kappers, L.A.; Sibley, W.A. (Physics Department, Oklahoma State University, Stillwater, Oklahoma 74074). Phys. Rev. B 8: No. 2, 773-779 (15 July 1973).

Optical studies on the absorption and emission of 3d impurity ions in MgF_2 are reported. It is found that the spin-forbidden transitions for these impurities are greatly enhanced by the presence of radiation defects. The spin-allowed transitions are not similarly enhanced. The sharp line structure accompanying several of these transitions is discussed as is the annealing of the radiation damage. (auth)

30700 EFFICIENT LUMINESCENCE CENTERS IN H- AND D-IMPLANTED 6H SIC. Patrick, L.; Choyke, W.J. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). Phys. Rev. B 8: No. 4, 1660-1669 (15 Aug 1973).

The luminescence center formed in SiC by H implantation and annealing is an H atom bonded to a C atom at a Si vacancy. It has high radiative efficiency at low temperatures because of the absence of Auger recombination. This model is derived from an annealing study and by an analysis of the three components of the phonon spectrum, (i) a 370-meV CH bond-stretching mode, (ii) two Si-vacancy localized modes, and (iii) many momentum-conserving modes. The change of frequency of these components on substituting D for H is large for (i), small for (ii), and zero for (iii). Inequivalent sites in 6H SiC permit three axial and three nonaxial centers, and five of the six expected spectra were observed. The site dependence of the polarization of localized-mode lines indicates a breakdown of the effective-mass approximation at the defect, for the polarization of momentum-conserving phonon lines is site independent. The H and D spectra are contrasted with the spectrum of the donor N. At 1.3 °K very nearly all the luminescence is due to the nonaxial centers, for recombination from the ground states of axial centers is spin forbidden. Thermally excited states were observed at various temperatures up to 26 °K. H and D luminescence was observed in 15R and 4H polytypes, but not in 3C. It is suggested that the usual defect is formed in 3C SiC but does not bind an exciton. (auth)

30701 CHANNELING AND DECHANNELING OF ION-IMPLANTED PHOSPHORUS IN SILICON. Reddi, V.G.K.; Sansbury, J.D. (Research and Development Laboratory, Fairchild Camera and Instrument Corporation, Palo Alto, California 94304). J. Appl. Phys. 44: No. 7, 2951-2963 (July 1973).

Profiles of channeled and dechanneled ^{31}P ions in the energy range 30-900 keV have been measured in <100>, <111>, <112>, and <110> Si. The maximum range, R_{max}, of the channeled ions has been determined and used to calculate values of electronic stopping power. The variation of these values with substrate orientation agrees qualitatively with that predicted by the Firsov theory, although the actual values are 2-3 times the Firsov prediction. Dechanneled profiles (450 keV) were measured in 0.3° steps up to 1.2° for all for orientations and in 2° steps up to 10° for the <100> and <111> orientations. The effect of tilt direction on the dechanneling was studied. Dechanneling from the <111>, <112>, and <110> orientations exhibited a marked sensitivity to the direction of tilt. By tilting in an appropriate maximum-dechanneling direction, dechanneling from the <100> and <111> orientations was found to be continuous, starting with the 0.3° tilt and saturating for tilts above 4.2°. The projected range, R_p, determined from the fully dechanneled or random distributions, was found to vary almost linearly with energy and has a slope of ≈ 1.1 μm/MeV. (auth)

30702 IONIZATION-ENHANCED DIFFUSION: ION IMPLANTATION IN SEMICONDUCTORS. Bourgoin, J.; Peak, D.; Corbett, J.W. (Physics Department, State University of New York at Albany, Albany, New York 12222). J. Appl. Phys. 44: No. 7, 3022-3027 (July 1973).

A model for the diffusion of implanted interstitials during implantation is introduced and shown to be able to account for the tails observed in ion profiles. It is argued that mechanisms of ionization-enhanced diffusion can explain some of the anomalous diffusion mechanisms observed in semiconductors. Indications for the existence of such mechanisms in the field of ion implantation in semiconductors are discussed. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

30703 (CONF-730301-P1, pp 619-627) APPLICATION OF PHOTOFISSION FOR THE QUANTITATIVE MEASUREMENT OF NUCLEAR REACTOR FUEL MATERIALS. Rundquist, D. E. (Gulf Radiation Tech., San Diego, CA). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Photonuclear techniques can be effectively utilized to obtain quantitative determinations of the amount of nuclear reactor fuel material in various forms. The photonuclear techniques are uniquely effective in measurements on large volume samples with a heterogeneous distribution of fuel material interspersed in an unknown matrix of nonfuel material. (auth)

30704 (CONF-730301-P1, pp 629-639) USE OF A 10-MeV LINAC FOR RADIOGRAPHY AND NUCLEAR MATERIALS SAFEGUARDS. Stegemann, D.; Grondey, J.; Krappel, W.; Wattecamps, E. (Technische Univ., Hanover). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A 10-MeV linear accelerator assembly for radiography and nondestructive measurement of fissile isotopes in reactor fuel materials is described. The assembly consists of a 4 to 10 MeV standing-wave, side-coupled electron linear accelerator and a Pretzel-type analyzing magnet. The performance characteristics of the main parts of the assembly were tested by measurements particularly in view of the requirements for application of the photofission-method for nuclear materials assay. Data are presented for stability and reproducibility of the Linac electron energy spectrum and current intensity under different operating conditions. The Pretzel analysing performance characteristics were also checked by test measurements. Of particular interest was the relation between attainable electron current and electron energy resolution. From the results it could be concluded that an improvement of energy resolution for 23% to 3.6% lowers the electron current by approximately 50%. The neutron measuring equipment is also described in detail. An outlook is given to the research program in which amongst others in the field tests are scheduled and a comparison of the photon-interrogation technique to the fast neutron-interrogation technique. (auth)

30705 PHOTONEUTRON ANTIMONY-124–BERYLLIUM SYSTEM FOR FISSILE MATERIALS ASSAY. Menlove, H. O.; Forster, R. A.; Matthews, D. L. (Los Alamos Scientific Lab., NM). Nucl. Technol.; 19: No. 3, 181-187 (Sep 1973).

An ^{124}Sb-Be(γ,n) assay system has been designed and fabricated for the measurement of fissile content in small samples, fuel rods, and solutions. The instrument uses multiple ^{4}He gas tube detectors to count fast neutrons induced in the assay sample by the ^{124}Sb-Be source neutrons. The ^{4}He detectors are biased to count only neutrons with energies above the 26- and 360-keV source neutrons. Computer calculations were used to optimize the design of the irradiation unit, giving a factor of ~3 improvement in the induced fission rate. The assay unit has been applied to the measurement of small UO_2 samples, pressurized water and boiling water reactor fuel rods, and high temperature gas-cooled reactor fuel. (auth)

Disposal and Storage

Refer also to abstracts 29766 and 30105.

30706 (SLA-73-596) PROGRAM ON THE OCEAN BASIN FLOORS AND RADIOACTIVE MATERIALS: DATA BASES FOR ASSESSING PRELIMINARY CONCEPTS. Bishop, W. P.; Hollister, C. D. (eds.) (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 44p. Dep. NTIS $4.25.

A workshop on the deep ocean basin floors and radioactive materials was held June 4 and 5, 1973, at Sandia Laboratories, Albuquerque, New Mexico. Participants included scientists and engineers from Sandia Laboratories and senior scientists from Woods Hole Oceanographic Institution, Scripps Institution of Oceanography, and Worcester Polytechnic Institute. A number of factors that make the deep ocean basins technically interesting for a nuclear waste repository were identified. In addition, a number of serious questions were raised that require answers before the feasibility of such a use for the deep basins can be judged. The study program begun as a consequence of this workshop, which is outlined herein, is therefore designed to answer the question: "Is it technically feasible and safe to use a deep ocean basin as a repository for radioactive wastes?" (auth)

30707 (TID-3311-S5) RADIOACTIVE WASTE PROCESSING AND DISPOSAL. (Technical Information Center (AEC), Oak Ridge, Tenn.). Sep 1973. 92p. Dep. NTIS $5.45.

A bibliography of 345 publications on all aspects of waste processing and disposal that have appeared in NSA Volume 27 (1973) is presented. The references are arranged in order by the original NSA abstract number which approximately places them in chronological order. Sequence numbers appear beside each reference, and the indexes refer to these sequence numbers. Corporate author, personal author, report number, and subject indexes are included. (LCL)

30708 PROBLEMS OF UNDERGROUND STORAGE OF WASTES. Nace, R. L. J. Res. U. S. Geol. Surv.; 1: No. 6, 719-723(1973).

Problems of underground storage of waste involve geology in its broadest sense, including hydrology, geochemistry, and geophysics. Wastes may be solid, liquid, or gaseous, and they may be chemically toxic or noxious, esthetically offensive, or radioactive. Some wastes require only temporary containment, whereas others must be isolated for indefinitely long periods. The means and locale for emplacement underground depend upon many governing geological factors, including the physical, chemical, hydrological, and hydraulic properties of the host formation. These must be studied relative to the physical, chemical, and thermal properties of the waste and of potential interactions between the waste and the host formation. Thorough knowledge is essential because lack of it may lead to undesirable or disastrous environmental consequences. Escape of waste may contaminate the surface or near-surface environment; it may destroy the usefulness or accessibility of resources such as ground water, petroleum, and minerals. Effective management of underground waste requires adaptation of current technology and development of new technology. (auth)

Handling Equipment and Procedures

Refer also to abstract 29786.

30709 (CONF-731101-3) MONTE CARLO ANALYSIS OF EXPERIMENTALLY CRITICAL PIPE INTERSECTIONS. Cross, N. F.; Whitesides, G. E.; Hinton, R. J. (Oak Ridge National Lab., Tenn. (USA)). 1973. 4p. Dep. NTIS $3.00.

Nuclear safety analysts often encounter situations in which criticality evaluations must be made for systems involving large tubing or piping arranged in various configurations. Those involving intersections cannot be calculated using the popular one-dimensional codes and no standards have been developed for the calculational reliability of other codes for this type of system. In this endeavor, calculations were made to determine the adequacy of the KENO and CHERI codes to treat critical systems of pipe intersections. (TFD)

30710 (Y-CDC-13) GENERIC ARRAY CRITICALITY: AN ANALYTIC REPRESENTATION OF REFLECTED ARRAYS OF FISSILE UNITS. Thomas, J. T. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1 Aug 1973. Contract W-7405-eng-26. 57p. Dep. NTIS $5.45.

The NB^2_N method for calculating parameters of critical arrays, which has been applied to cubic arrays, is extended to a general surface density analysis of criticality for fissile materials. Criticality of the materials U(93.2), ^{239}Pu, and ^{233}U as air-spaced units in reflected arrays is characterized by two constants: one dependent upon the geometry and the second upon the fissile material. The analytic expressions derived permit the quantitative evaluation of commonly employed factors of safety used in criticality safety specifications. The magnitudes of these factors and their interrelationships are displayed. The concepts are applicable to other fissile materials. (auth)

30711 STORAGE SYSTEM FOR RADIOACTIVE SAMPLES. Technical Note N.1232. Luxemburg; Commission of the European Communities ([nd]). 4p. (In Several Languages).

Previously, the storage of large amounts of irradiated samples required a special hot cell containing vertical storage tubes in a concrete floor of almost prohibitive surface area. The new system uses a mobile hot cell. It can be moved on rails across the storage area in such a way that all tubes can be serviced. The mobile cell is constructed like a hot cell, but has no floor. A weak negative pressure insures that the air current always flows toward

the interior of the cell. The dimensions of the cell can be adjusted to the space needed by the manipulator. Details are given by the German public report No. 1.639.217, the French patent No. 1.596.421, and the British patent No. 1.225.951. (HBG)

30712 DEVICE FOR THE CUTTING OF IRRADIATION CAPSULES. Technical Note N.769. Luxemburg; Commission of the European Communities ([nd]). 4p. (In Several Languages).

A capsule opener for the lengthwise cutting of radiation capsules is described. It can be handled easily with a manipulator and, therefore, it is particularly suited for use in hot cells. The capsule is opened first at its two ends. The capsule then is clamped between two tongs attached to the opening device. An adjustable depth cutting device, driven by a screw-spindle steering gear, then opens the capsule without any deformation. Further details are given in the French patent 1.553.918 and the German public report No. 1.589.757. (HBG)

Transportation

30713 (CONF-731101-14) VALIDATION OF MONTE CARLO CALCULATIONS OF SHIPPING CASK SYSTEMS. Petrie, L. M.; McCarty, P. G. (Oak Ridge National Lab., Tenn. (USA)). 1973. 5p. Dep. NTIS $3.00.

As nuclear power develops and more reactors are built, there is strong economic pressure to develop shipping casks which can be used to ship multiple fuel elements. Because of the high k-effective of individual fresh fuel elements, puting more than one element in a cask presents the possibility of the cask achieving criticality. Various stratagems are used to reduce this possibility, such as separating the fuel elements, placing them in irregular patterns and interspersing poison between them. While these all have the desired effect, they tend to change the cask to a system unlike a reactor. This change places in question the calculational methods used to compute k-effective for the cask, for while these methods have been extensively validated for reactors, there has been little opportunity to validate them for non-reactor systems. Another feature of shipping casks is a thick, heavy metal shroud used for shielding gammas from irradiated fuel elements. This shield, usually lead or depleted uranium, forms a heavy metal reflector for the fuel elements in a cask and has no counterpart in a reactor. Because some of the proposed casks have quite high calculated k-effectives, the calculational techniques and the cross sections used need to be validated against experiment. Such experiments were carried out and comparisons of Monte Carlo calculations made using the KENO code with the experimental results are presented. (auth)

30714 (STI/PUB-324) ADVISORY MATERIAL FOR THE APPLICATION OF THE IAEA TRANSPORT REGULATIONS. Safety Series No. 37. (International Atomic Energy Agency, Vienna (Austria)). 1973. 199p. IAEA $7.00.

This advisory document sets forth supplementary information to the Regulations for the Safe Transport of Radioactive Materials (Safety Series No. 6, 1973 Revised Edition, IAEA, Vienna) which may be useful in deciding "how" to achieve the necessary level of protection. Some practical recommendations in terms of constructional details based on experience of certain Member States are given. Wherever possible, the specific information is directed towards the users concerned. These include: designers, manufacturers, competent authorities, applicants for approval, consignors, carriers, customs authorities, and emergency teams. (TFD)

30715 ADMINISTRATIVE GUIDE FOR OBTAINING DEPARTMENT OF TRANSPORTATION SPECIAL PERMITS FOR RADIOACTIVE MATERIALS SHIPMENTS. New York; American National Standards Institute, Inc. (1973). 8p. (ANSI-N14.10.2-1973).

This standard sets forth the procedure for requesting special permits from the U. S. Department of Transportation (DOT) for packages or transport methods that do not meet the existing DOT regulations for radioactive materials. It outlines and explains the information required by DOT in requests for special permits for exemptions or waivers from DOT regulations. It is not applicable to requests for Atomic Energy Commission approvals of packages referenced in Title 49, Code of Federal Regulations, Part 173.394, Radioactive Materials in Special Form; Part 173.395, Radioactive Materials in Normal Form; or Part 173.396, Fissile Radioactive Material. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

30716 (CONF-730301-P2, pp 1017-1018) THERAPEUTIC AND DOSIMETRIC ASPECTS IN THE TREATMENT OF MALIGNANT TUMORS WITH A 30-MeV BETATRON. Birzu, I. (Cantacuzinc Hospital, Bucharest); Grigorescu, S.; Scarlat, F. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The 30-MeV betatron at the Bucharest Institute for Atomic Physics is briefly described and is used for lung cancer therapy is outlined. (WHK)

30717 (CONF-730301-P2, pp 1123-1134) PHOTONUCLEAR REACTIONS AND APPLICATIONS IN CANCER THERAPY. Almond, P. R. (M. D. Anderson Hospital and Tumor Inst., Houston, Tex.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The use of high-energy accelerators producing x rays and electrons for radiotherapy treatment of cancer is discussed. There are advantages to going to higher energy x rays but these produce problems in flattening the beam and in photonuclear reactions producing neutrons, which must be measured. When electrons are used it is important to know the energy in order to treat a given tumor. Known photonuclear reaction thresholds are used to calibrate the energy of these electron beams. Since the introduction of these machines, cure rates in cancer therapy have increased and some of the increase can be related to the radiations. (auth)

30718 (CONF-730301-P2, pp 1225-1239) MICROTRON AND ITS APPLICATIONS. Baciu, G. (Inst. for Atomic Physics, Bucharest). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The basic principle of microtron-type electron accelerators used as electron, gamma, and neutron sources in the energy region 5 to 30 MeV is described. The possible applications in nuclear physics research, gamma and neutron activation analysis, high-energy radiation therapy of malignant tumors, and nondestructive testing in industry and nuclear energy fields are discussed. (auth)

30719 (CONF-730301-P2, pp 1241-1248) FUTURE ACCELERATORS FOR PHOTONUCLEAR STUDIES. Leiss, J. E. (National Bureau of Standards, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The status of electron accelerator developments and the need for new accelerators in photonuclear studies is discussed. The development of 100 percent duty cycle accelerators is identified as a major goal. Specific accelerators which would satisfy this goal are identified. The possibility of modifying existing facilities to enhance the application of photon activation analysis is given as an example of ways in which photonuclear applications can be encouraged. (auth)

30720 (KFK-1764) GESSS MACHINE DESIGN COMMITTEE REPORTS, 1972. Green, M. A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jun 1973. 96p. Dep. NTIS (U. S. Sales Only) $7.50.

The Group on European Superconducting Synchrotron Studies (GESSS) is a collaboration by the laboratories RHEL (Great Britain), CEN Saclay (France), CERN II and IEKP Karlsruhe. The Machine Design Committee of GESSS is concerned with studying possible alternatives from the point of view of accelerator design that may be seen in an extension of the CERN II 300-GeV proton synchrotron to 1000 GeV employing superconducting magnets. Contributions to this committee are compiled on these topics: (1) cost estimates for a separate ring of superconducting magnets; (2) effects of magnet length and distance on cost and final energy; (3) cryogenic and vacuum-related problems in a given tunnel; and (4) effects of aberrations in the magnetic field due to persistent currents on beam dynamics. (auth)

30721 (NIIEFA-D-139) REASON OF ELECTRON LOAD ORIGINATION IN ACCELERATING TUBES OF ELECTROSTATIC ACCELERATORS. Zheleznikov, F. G.; Yakovlev, N. M.; Bersenev, Ya. T.; Garenkov, V. S. (Scientific Research Inst. of Electro-Physical Apparatus. Leningrad (USSR)). 1972. 24p. (In Russian). INIS.

The leakage beams through the vacuum insulation of accelerating tubes often limits the operating voltage of the electrostatic accelerator. Experimentally it was shown that the conductivity of the vacuum insulations can be caused by the emission spots originating on the surface of the cathodes under the effect of discharge phenomena. A model was proposed explaining the causes for the origin of the leakage current in accelerator tubes. (tr-auth)

30722 (NIIEFA-D-145) CHARACTER OF ELECTRON LOAD IN ACCELERATING TUBES OF ELECTROSTATIC ACCELERATORS. Zheleznikov, F. G.; Yakovlev, N. M.; Bersenev, Ya. T. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)). 1972. 17p. (In Russian). INIS.

The results of studies with the purpose of explaining the nature of electron load arising in accelerator tubes are reported. The emission properties of the dielectric formation on the cathode formed during discharge between electrodes and contaminated with organic materials were studied. The generality of the emission properties of the dielectric formation and emitters was established. (tr-auth)

30723 FEASIBILITY AND COST OF A SUPERCONDUCTING HEAVY ION LINEAR ACCELERATOR. Jones, C. M. (Oak Ridge National Lab., TN). Particle Accel.; 5: No. 1, 45-60 (1973).

Design, cost, and feasibility studies for a heavy-ion linear accelerator utilizing superconducting resonant cavities are described. Comparisons are presented between this accelerator and several other conceptual designs. (48 references) (auth)

30724 METHOD OF LOCATING DEFECTS IN A HIGH-VOLTAGE INSULATING TUBE. Gray, J. W.; Hartnell, G. W.; Legg, J. C. (to United States Atomic Energy Commission). US Patent 3,761,720. 25 Sep 1973. Filed date 30 Aug 1972. 8p.

Defects causing backstreaming of electrons in a Van de Graaff generator are located by determining the endpoint energy of the x-ray spectrum resulting from the stopping of these electrons, taking a ratio of the voltage associated with the end-point energy to the machine-generated voltage, and using this ratio as a fraction of the generator length to determine defect location. (Official Gazette)

Auxiliaries and Components

Refer also to abstracts 29990 and 31375.

30725 (CONF-730301-P2, pp 1019-1020) ENERGY CALIBRATION OF THE ASTRON ACCELERATOR. Weiss, P. B. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

An absolute energy calibration of the energy analyzing magnet system for the Astron accelerator was performed. The method employed the threshold of neutron production by incident photons on several different target materials. A beam current of 200 to 300 amps was employed. The electron beam impinged upon a water cooled tantalum target to produce the γ flux. (WHK)

30726 (CONF-730301-P2, pp 1039-1047) EROS: THE ELECTRON RING OF SASKATOON. Servranckx, R. (Univ. of Saskatchewan, Saskatoon). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

After presenting the purpose of the electron ring pulse stretcher and situating it with respect to other projects, the basic theory and principles underlying the design are presented. A schematic layout is described. The main characteristics of the hardware are presented, and a description of the possible outputs expected from the ring is given. (auth)

30727 (EFI-10(72)) INVESTIGATION OF SELF-BALANCING PROCESS OF A MAGNETIC SYSTEM OF ACCELERATORS. Karabekov, I. P. (Erevanskij Fizicheskij Inst. (USSR)). 1972. 67p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.50.

The results of theoretical and experimental investigations of the self-balancing process of the magnetic system of a synchrotron are given. It is shown that the dynamic disturbances of field parameters

caused by the alternating part of a feeding current are almost completely excluded. The fundamental relations between the values of the disturbance both of the field and gradient and the coordinating parameters of connecting elements of self-balancing circuits are presented. The experiment proves the usefulness of these relations for the designing of synchrotron magnets. (auth)

30728 (IFVE-INZ-72-44) AUTOMATIC LIMIT CONTROL SYSTEM OF MAIN PARAMETERS OF I-100 LINAC. Kuznetsov, S. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 8p. (In Russian). INIS.

The five-channel system for the automatic limit control of the basic parameters of the I-100 linear accelerator was described. The system makes it possible to control the level of the accelerating rf field in the resonators and the beam current. As a result of controlling parameters beyond the permissible limits of the system, light and acoustical signals were produced. The system described differs from other limit control devices by the much high stability. The long-term instability of the control during signals with amplitudes of 10 V does not exceed ±0.2%. (tr-auth)

30729 (IFVE-ORZ-72-47) PENETRATING RADIATION FLUX DISTRIBUTION IN THE SHIELDING OVERLAP OF THE 70-GeV ACCELERATOR HALL. Britvich, G. I.; Getmanov, V. B.; Lebedev, V. N.; Mal'kov, V. V.; Semenova, G. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 25p. (In Russian). INIS.

On the 70-GeV IFVE synchrotron an experimental study was carried out of the transmission of neutrons with energy E > 20 MeV in the upper shield of the accelerator hall in geometry typical for ring accelerators. The attenuation of the neutrons in the shield is described by the Moyer reference model with attenuation parameters $l = 121 \pm 6$ g/cm^2. Storage factors of different neutron energy groups in the shield and the spatial distribution of the neutrons in the shield are represented. The results of the measurements are compared with the data of other authors. (tr-auth)

30730 (ITEF-944) TIMING THE OPERATION OF THE ITEF LINEAR PROTON ACCELERATOR PULSE DEVICES TO ENSURE THE MULTI-PURPOSE USE OF THE ACCELERATOR. Kozodaev, A. M.; Korchagin, Yu. E. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1972. 17p. (In Russian). INIS.

Information on the development of the electron device for the timing and distribution of the start-up signal of the pulse system of the linear proton accelerator I-2 is reported. The device makes it possible to realize the possibility of simultaneous multipurpose use of the accelerator. (tr-auth)

Ion Sources and Injection and Extraction Systems

30731 (ISN-1972, pp 10-12) SOURCE OF MULTICHARGED HEAVY IONS. Bouchaib, P.; Fruneau, M.; Eybert Berard, A.; Lieuvin, M.; Moya, A.; Perrier, H.; Rallu, G.; Ravel, J. C. 1972. (In French).

REFLEX sources were developed and tested with a view toward developing an internal source for the cyclotron. (FR)

Ion Optics and Field Calculations

30732 (CONF-730301-P1, pp 243-244) SIX TRAVERSAL MICROTRON USING A SUPERCONDUCTING LINAC. Allen, J. S.; Axel, P.; Hanson, A. O.; Harlan, J. R.; Hoffswell, R. A.; Jamnik, D.; Robinson, C. S.; Sutton, D. C.; Young, L. M. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A six-traversal system which recirculates the electrons through a 100% duty cycle linac is described. The entire system, except for the linac, could accommodate 60-MeV electrons. A 600-MeV superconducting microtron would be practical with a larger linac and larger 180° magnets. (LTW)

30733 (CONF-730301-P1, pp 245-246) LIFR LINATRON PROJECT. Gonella, L. (Instituto Nazionale di Fisica Nucleare, Turin); Barbero, D. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

An acceleration scheme (called Linatron) is described that utilizes the recycle of a linac section on a race-track microtron pattern. The maximum energy of the machine is 500 MeV to be reached with a 36-fold recycle at 13.5 MeV through 1.2 T magnets after injection at about 11.5 MeV. One power klystron is sufficient for the whole systems, feeding in parallel the recycled and injection systems made of conventional constant-field traveling-wave guides. The Linatron is suited for short-pulse operation. (LTW)

30734 (NIIEFA-B-152) ASPECTS OF PARTICLE DYNAMICS IN ACCELERATOR WITH STRONG COUPLING OF TRANSVERSE OSCILLATIONS. Belov, V. P. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)). 1972. 29p. (In Russian). INIS.

The dynamics of the particles in an accelerator with three-dimensional orbits were studied. The Floquet functions of the bound motions and the frequencies of the betatron oscillations were found. The resonances in the perturbation field were examined. (tr-auth)

30735 (NIIEFA-B-153) ASPECTS OF PARTICLE DYNAMICS IN SUPERCONDUCTING SYNCHROTRON WITH STATIONARY FIELD. Belov, V. P. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)). 1972. 32p. (In Russian). INIS.

The Floquet functions of the bound motions were found. The linear resonances were examined. The tolerances on the mean-square dispersal at the curvature of the magnet and the lens gradient were determined. (tr-auth)

30736 NANOSECOND TIME INTERVALS COMPARATOR. Zabierowski, J. (Univ., Lodz, Poland). Nukleonika; 18: No. 5, 229-238(1973). (In Russian).

A nanosecond time intervals comparator is described. It is intended for use in the accelerator physical experiments, where the "time of flight" method is used. The device compares time intervals with the accuracy $\pm 0.4 \times 10^{-9}$ sec when the dispersion of scintillator counter pulse amplitude is 26%. (auth)

30737 ACHROMATIC DEFLECTION SYSTEM WITH ADJUSTABLE NONISOCHRONISM FOR PARTICLES WITH DIFFERENT MOMENTA. Basargin, Y.G.; Severgin, Y.P. (D. V. Efremov Institute of Electrophysical Apparatus). Sov. Phys.–Tech. Phys. 17: No. 8, 1380-1384 (Feb 1973).

The principle of combining symmetrical achromatic deflecting systems with adjustable effective length is considered. A deflection system consisting of one 270° magnet, two 135° magnets, and two quadrupole lenses is given as an example. Adjustable achromatic systems can be used for bunching and monochromatizing of beams, and also for isochronous transport of nonmonoenergetic particles. (auth)

30738 LIMITING CURRENT IN LARGE CYCLIC ACCELERATORS AND STORAGE RINGS. Deryugin, G.M.; Shukeilo, I.A. (D. V. Efremov Scientific–Research Institute of Electrophysical Apparatus, Leningrad). Sov. Phys.–Tech. Phys. 17: No. 8, 1301-1302 (Feb 1973).

Calculations refining the criterion for static stability of a beam in a cyclic system are reported. Calculations are carried out for an elliptic beam of finite transverse dimensions between plane-parallel vacuum-chamber walls and plane-parallel magnet poles. (auth)

30739 EFFECT OF THE MOMENTUM-CUTOFF INSTABILITY ON THE OPERATION OF A CYCLIC ACCELERATOR. Didenko, A.N.; Privezentsev, A.P.; Fomenko, G.P. Sov. Phys.–Tech. Phys. 17: No. 8, 1303-1307 (Feb 1973).

An analysis is made of the effect of hybrid modes excited by a beam on the stability of betatron oscillations in a synchrotron with waveguide accelerating sections. The effective focusing in a cyclic accelerator is shown to weaken the deflecting effect of the hybrid mode. The limiting number of particles accelerated is estimated for various operating modes. (auth)

30740 TRANSIENT PHENOMENA IN HIGH-CURRENT ELECTRON BEAMS. Raizer, M.D. (P. N. Lebedev Physics Institute, Academy of the USSR, Moscow). Sov. Phys.–Tech. Phys. 17: No. 8, 1308-1310 (Feb 1973).

Transients appearing during the generation of pulsed high-current electron beams in a vacuum tube diode and in the injection of a beam into the vacuum drift tube and plasma are studied. It is shown that transient phenomena can limit the maximum current and change the electron energy spectrum considerably for current pulses of the order of 10^5 to 10^7 A. (auth)

30741 EMITTANCE, ENTROPY, AND INFORMATION. Lawson, J. D. (Rutherford Lab., Chilton, Eng.); Lapostolle, P. M.; Gluckstern, R. L. Particle Accel.; 5: No. 1, 61-65(1973).

The emittance of a charged particle beam can be considered as a measure of the disorder in the transverse motion of the

particles. The relation of this concept to the entropy of the distribution in transverse phase space is explored, and a thermodynamic description of a beam as a "two dimensional gas" is developed. The connection with information in beams which can be focused to form an image is noted. (auth)

30742 NONLINEAR BETATRON OSCILLATIONS. Lysenko, W. P. (Yale Univ., New Haven). Contract AT(11-1)-3075. Particle Accel.; 5: No. 1, 1-21(1973). (COO-3075-32).

An analytic study is made of single particle motion in two dimensions for a nearly linear, nearly periodic system by considering a set of perturbed Hill's equations. It is shown how the Krylov-Bogoliubov averaging method can be applied to a nearly periodic system which may be near resonances to all orders in the perturbation parameter. The particular case of a single resonance in the first approximation is treated in detail. The fourth order system of differential equations is reduced to a second order system which describes the amplitude behavior for either the sum or the corresponding difference resonance. Approximate solutions are obtained for the betatron amplitude as a function of the independent variable for the cases in which the operating point is fixed, moves parallel to a resonance line, crosses a resonance line, or passes close by a resonance line. As a practical example, the particle losses in a storage ring due to an arbitrary nonlinear resonance are calculated in terms of the error fields. (auth)

30743 LONGITUDINAL MOTION OF PARTICLES IN STORAGE IN INDUCED FIELDS DEPENDENT ON THE RADIUS. Kozin, V. P.; Shenderovich, A. M. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 4, 599-604(1973). (In Russian).

A theoretical investigation was made of the longitudinal motion of a beam in storage in the presence of collective or induced fields dependent on the radius. A general equation was obtained for synchrotron oscillations taking into account the dependence of the longitudinal components of these fields on the radius and distortion of the equilibrium orbit affected by their transverse components. In contrast to the case of external fields the allowance of these effects leads to an essential variation of the character of synchrotron oscillations. A particular case of the longitudinal instability of δ-line cluster interacting with an arbitrary-type resonator is considered. The dependence of the induced field on the radius can make an essential contribution to the instability increment. (auth)

30744 CORRECTION OF EDDY CURRENT ERRORS IN ELECTRON BEAM DEFLECTION. Wardly, G.A. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 44: No. 8, 3766-3769 (Aug 1973).

When electron beams are to be rapidly and accurately deflected by magnetic means, there are some cases in which the deflection yoke is surrounded by a conducting magnetic tube. Eddy currents are set up in the tube which result in time-dependent positional errors. A simplified treatment of the problem shows how the positional errors can be reduced by means of compensating coil pairs or hybridized saddle-toroidal yokes. (auth)

30745 QUANTUM THEORY OF ELECTRON-CAVITY INTERACTIONS. Chang, C.S.; Stehle, P. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. A 8: No. 1, 318-327 (July 1973).

The quantum-theoretic method developed in one of our earlier papers is applied to the interaction of an electron with a multicavity system. This analysis is extended to the two-cavity oscillator, linear accelerator (linac), and frequency mixer. It is found that the experimental observations done so far in the above systems do not depend on the quantum state of the cavity field. A comparison of the oscillator theory and the linac given here indicates that the weak-field limit should be taken as the correct classical limit according to the generalized correspondence principle. Finally, a possible refinement of linac design, as a result of the present calculation, is pointed out. (auth)

Storage Rings

30746 (COO-1112-180) LARGE APERTURE SPECTROMETER MAGNET FOR THE ISA AND THE POSSIBLE USE OF VISUAL DETECTORS. French, H.; Roe, B. P.; Gelfand, N.; Strand, R. C.; Weilhammer, P. (Brookhaven National Lab., Upton, N. Y.). 1972. 6p. (BNL-17142). Dep. NTIS $3.00.

It is proposed that a large aperture spectrometer magnet be designed as an integral part of the ISA machine to be pulsed with the machine. The design luminosity thus can be optimized in a configuration including the large magnet. Some preliminary options concerning magnet types are given, and it is argued that as a first survey it is likely to be used with visual detectors. At the ISA, as at lower energies, the strong forces will dominate the p + p interaction. The typical p + p event will be characterized by high track multiplicity and the small transverse momenta of the particles. It is felt that the understanding of these events will be essential to achieve an explanation of the strong interaction. It is therefore considered important that the ISA be provided with a device which enables one to observe and analyze these events. (auth)

30747 (COO-1112-181) VISUAL DETECTORS FOR ISA. Roe, B.; French, H. (Brookhaven National Lab., Upton, N. Y. (USA)). 12 Oct 1972. 6p. (BNL-17273). Dep. NTIS $3.00.

A facility for visual surveys of 200 × 200 GeV p + p interactions at ISABELLE is proposed. It is suggested that the initial design of ISABELLE include an intersection region immersed in a large volume magnetic field and that streamer chambers be used inside the magnet and streamer chambers or proportional wire chambers be used outside. (WHK)

30748 (RL-73-87) SHIELDING FOR EPIC: FIRST ESTIMATES. Perry, D. R. (Rutherford High Energy Lab., Chilton (England)). Aug 1973. 3p. Dep. NTIS (U. S. Sales Only) $3.00.

The procedures and results of estimations for the shielding for the EPIC booster and the main ring are outlined. (WHK)

30749 (RL-73-91) BEAM SEPARATION IN THE EPIC II e-p OPTION. Maidment, J. R. (Rutherford High Energy Lab., Chilton (England)). Aug 1973. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

When both electron and proton beams are being accelerated in EPIC there is the possibility of the beams colliding where the β-values are such that the beam-beam interaction may cause beam loss. A description is given of one possible beam separation system designed to prevent such an occurrence. Approximate parameters are evaluated for the system and the apertures necessary to contain the separated beam orbits are computed. (UK)

30750 CERN PROTON STORAGE RINGS. Keil, E. (CERN, Geneva). Kerntechnik; 15: No. 8, 366-378(1973). (In German).

The CERN Intersecting Storage Rings (ISR) are described. First, the basic principles for the operation of proton storage rings and the requirements imposed on their components are discussed, then the technical realization of these components is described in detail. The beam behavior in the ISR and high-energy physics experiments at the ISR are briefly mentioned. (GE)

30751 TENTATIVE DESIGNS FOR A STORAGE RING FOR IMPROVING THE DUTY FACTOR OF A 40-MeV ELECTRON LINAC. Westcott, C. H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Particle Accel.; 5: No. 1, 23-44(1973).

Details of a design for a storage ring for duty-factor improvement of the beam of an ~40-MeV electron linac are given. Such linacs have typically a duty factor of ~0.1%, and Knowles has shown that the research programme, based on such a linac, could be considerably broadened if the duty factor could be raised to near unity (say 60 to 95%) without increasing the mean current. By contrast with prior proposals at higher energy, simplicity and relatively low cost are achieved in the present designs at the price of restricting the spread of energy ΔE of the stored electrons to $\Delta E/E \approx 0.1$ to 0.15%, this being acceptable for the experiments proposed. In order to examine how the linac beam emittance available and the energy range to be stored may influence the design, four alternative tentative ring designs are presented. Factors which may influence the final choice of design for a particular installation are also discussed in relation to the practical limitations of available components. (auth)

Experimental Facilities

30752 (CONF-730301-P1, pp 269-270) "TAGGED BREMSSTRAHLUNG" METHOD TO MEASURE PHOTONUCLEAR CROSS SECTIONS. Costa, S.; Ferrero, L.; Pasqualini, L. (Univ., Turin). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

One procedure for measuring photonuclear cross sections is to determine the yield at two slightly different bremsstrahlung end points, taking a suitably normalized difference between the two sets of data. A particular version of the single-difference method is described which allows the collection of the useful data in a single run. (LTW)

30753 (CONF-730301-P1, pp 273-274) LIVERMORE PHOTONEUTRON CROSS-SECTION EXPERIMENT. Fultz, S. C.; Berman,

B. S.; Alvarez, R. A.; Meyer, P. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The experimental layout for one of the annihilation-photon beam lines at the new Livermore electron–position linear accelerator is shown. (LTW)

30754 (CONF-730301-P2, pp 1021-1022) NEUTRON DIFFRACTION AND CONDENSED MATTER ANALYSIS USING PHOTONEUTRON BURSTS FROM LINAC. Kimura, M. (Tohoku Univ., Sendai). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Efforts were directed to exploit the potentiality of the photoneutron bursts produced by an electron linac as a tool for the analysis of various static and dynamic structures of the condensed matter. Thermal neutron bursts of the flux intensity of about 10^{12}n/sec cm^2 with the duration of 20 ~ 50 μsec were produced without using any amount of fissile material at the surface of a properly poisoned water moderator with a W target at the center of it. The W target was bombarded by the electron beam from the Tohoku University 300-MeV linac. Various devices of the time-of-flight type spectrometry of neutrons were designed and installed in front of neutron beam holes surrounding the target-moderator assembly. (WHK)

30755 (CONF-730301-P2, pp 1033-1034) PHOTONEUTRON RADIOGRAPHY. Hewitt, J. S.; Blumenauer, G. R. (Univ. of Toronto). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

It was demonstrated by using an electron linear accelerator operated at 35 MeV and 4 KW beam power incident on a water-cooled tungsten target that the transfer imaging technique can be used to obtain high quality thermal and resonant neutron radiographs, and the pulsed characteristics of the linear accelerator permit "stroboscopic" neutron radiographs to be obtained for the examination of cyclical processes. (WHK)

30756 (CONF-730301-P2, pp 1249-1261) SURVEY OF MONOCHROMATIC PHOTON CAPABILITIES: TECHNOLOGIES: AND USES. Schuhl, C. (CEN de Saclay, Gif-sur-Yvette, France). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Methods for producing monochromatic photons and determining the energy of interacting photons are reviewed. The survey is made of five parts corresponding to the different techniques: (1) the nuclear gamma rays obtained by nucleon capture; (2) the manner used for working with bremsstrahlung spectra, in particular tagging; (3) the photon spectrometer methods; (4) the positron annihilation-in-flight; and (5) the backscattered laser beam. The principle of the method, an experimental layout, and the type of experiment obtained in each case are described. (49 references.) (auth)

30757 CONSIDERATIONS AS TO A RF-RECOIL SPECTROMETER FOR THE ACCELERATOR LABORATORY IN MUNICH. Skorka, S.; Rudolph, K.; Hertel, J. (Univ., Munich). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

The planned HF-recoil spectrometer for the accelerator laboratory in Munich is described. The spectrometer mainly consists of a separator, which separates the fission products spatially from the greater part of the projectiles, and a time-of-flight spectrometer, with which the mass of the fission products at the time can be measured from the time-of-flight and energy. The mass resolution m/ΔM is approximately 70 to 80. (GE)

30758 DEGENERATION OF TRITIUM TARGETS. Hiracka, E.; Furuta, J.; Fujishiro, M.; Kanazawa, T.; Ohnishi, T. . (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 86-93(Mar 1973).

Tritium targets are used for the neutron source of low-voltage accelerators. The damage of tritium targets and contamination observed are reported. The contamination of tritium is caused by titanium fragments generated during the accelerator operation. The tritium gas contamination in the accelerator tube and vacuum pump oil reported so far might be due to titanium fragments. (auth)

30759 AUTOMATIC SYSTEM FOR MEASURING ORIENTATIONAL EFFECTS. Kolyada, V. M.; Arkhipovich, V. A. (All Union Scientific-Research Inst. of Analytical Instrument Design, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 503-505(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 147-149(1973).

A system is described that allows simplification and automation of the process of measuring orientational effects involved in the replacement of mechanical displacements of a sample and an ion counter by proton-beam scanning. In order to achieve a rigorous registration of the irradiation dose a device that automatically switches off the beam when a predetermined stipulated magnitude of this dose is reached has been introduced into the system. (auth)

30760 PRODUCTION OF ^{15}O BY VAN DE GRAAFF ACCELERATOR. Cress, L. W.; Rydin, R. A. (Univ. of Virginia, Charlottesville). Phys. Med. Biol.; 18: No. 5, 742-743(Sep 1973).

The University of Virginia's 5.5 MeV Van de Graaff accelerator has been used to verify calculations suggesting medically useful quantities of ^{15}O could be produced. A 10 cm^3 gas target cell with a 5 μm thick molybdenum entrance window was filled with nitrogen at a pressure of 1.7 atm and bombarded with 5-MeV deuterons at a beam current of 8 μA. After a 10 min bombardment, the gas was transferred to a counting chamber, the yield being determined by counting the resulting position activity, using the $\nu-\nu$ coincidence method. A yield of 30 ± 6 mCi was measured, corrected to the end of the bombardment. It is suggested that if the beam current were increased to the capacity of the machine and a target cell with a larger entrance window were used, the yield would be significantly increased. (UK)

30761 LAMPF: EXPERIMENTAL AREA, CAMAC DATA LINK LOGIC DIAGRAM (19 Jan 1973) (ENGINEERING MATERIALS). (Los Alamos Scientific Lab., N. Mex.). (CAPE–2362).

2 drawings.

Drawings for the LAMPF CAMAC Data-Link which has been designed to allow high-speed digital communications between two or more CAMAC-based computer data acquisition systems are presented. (TFD)

30762 INVESTIGATION OF TRITIUM CONTAMINATION ON TITANIUM ION-GETTER PUMPS. Biro, J. (Central Research Inst. for Physics, Budapest). pp 625-629 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The titanium ion-getter pumps in neutron generators are exposed to contamination from the tritium gas released from the targets. Examinations of an ion-getter pump removed from a neutron generator after two years of operation are reported. The pattern of tritium contamination in the different structural elements established by activity measurement and autoradiography are discussed and procedures for safe handling and regeneration of the contaminated pumps are suggested. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 29976 and 30888.

30763 (AD-760789) INTENSITY TIME VARIATIONS OF THE COSMIC RADIATION. Final Report, 1 November 1968–31 January 1973. Lockwood, J. A. (New Hampshire Univ., Durham. Dept. of Physics). Feb 1973. Contract F19628-68-C-0107. 156p. (AFCRL-TR-73-79). NTIS.

The changes in the cosmic-ray intensity over the last solar-modulation cycle are presented using the data from the Mt. Washington and Durham neutron monitors. Observations on a particular event occurring January 26, 1968, are reported. Comparisons of the counting rates of neutron monitors, of the different neutron multiplicities at Durham and Mt. Washington, and of the Pioneer 8 cosmic-ray telescope indicated the form of the modulation was different for the 11-year variation and for Forbush decreases during 1968–1970. (NTIS)

30764 MEASUREMENTS OF ABSOLUTE INTENSITIES OF COSMIC-RAY MUONS IN THE VERTICAL AND GREATLY INCLINED DIRECTIONS AT GEOMAGNETIC LATITUDES 16°N. Karmakar, N. L.; Paul, A.; Chaudhuri, N. (Univ. of North Bengal, Rajarammohunpur, India). Nuovo Cim.; 17B: No. 1, 173-186(11 Sep 1973).

Absolute integral intensities of vertical cosmic-ray muons with minimum momentum in the range 0.35 to 2.7 GeV/c and of muons at large zenith angles in the range 75 to 89° were measured by using a very-narrow-angle scintillation counter telescope. In this momentum range the vertical intensities were found to be consistently higher than the standard Rossi integral spectrum at geomagnetic latitude 50°N, but 4 to 5% lower than the best-fit integral intensities up to 1 GeV/c of Allkofer et al., this difference of the present intensities from those of Allkofer et al. being consistent with latitude variation of the muon spectrum. A comparison of the present results with some of the other absolute measurements at lower and higher geomagnetic latitudes is given to show the significant deviation of most of the previous measurements at lower latitudes from the present measurements. The absolute intensities in the inclined directions were measured in the zenith-angle range 75 to 89° by using the same apparatus. The measured intensities were somewhat lower than the previous measurements, but consistent with the theoretical zenithal distribution according to the calculation of Ashton et al. The present results in agreement with that of Hicks et al. tend to lie between two estimates made assuming kaon-to-pion ratio of 0 and 0.4. The near cosine-square zenithal distribution law up to the zenith angle 73° is found to be changed in the range 75 to 85° to a form with an exponent 1.86. (auth)

30765 INFLUENCE OF ENERGY-DEPENDENT ESCAPE FROM THE GALAXY ON COSMIC ELECTRONS. Silverberg, R. F.; Ramaty, R. (Goddard Space Flight Center, Greenbelt, MD). Nature (London) Phys. Sci.; 243: No. 130, 134-135(25 Jun 1973).

It is considered that the escape of cosmic rays from the Galaxy may be energy dependent, this conclusion being reached from observed ratios of secondary to primary nuclei. Secondary nuclei appear to have steeper spectra than their primary progenitors, suggesting that the escape probability may increase with increasing energy. A consequence is that the effects of synchrotron and Compton losses on the electron spectrum are diminished. An equation is developed for the propagation of cosmic electrons in the Galaxy above a few GeV. (UK)

30766 EVIDENCE OF FEATURES IN ATMOSPHERIC SPECTRA AT AROUND 8 CM^{-1} OF PROBABLE SOLAR ORIGIN. Baluteau, J. P.; Bussoletti, E.; Epchtein, N. (Observatorie de Paris-Meudon, France). Nature (London); 244: No. 5418, 562-563(31 Aug 1973).

It is stated that in studies of emission spectra of the stratosphere, made from a Caravelle aircraft during night and day flights, an unexpected feature always appeared in the day spectra around 8 cm^{-1}, but never in the night spectra. Day and night flights were made and the spectra compared in order to find any effects due to the possible existence of photoreactions or other phenomena induced by the Sun. It was considered that time fluctuations of the atmospheric background might cause the kind of features observed, and a power analysis of the unexpected signal was carried out to determine its time characteristics. Three power spectra of consecutive interferograms are shown. Measurements were made at an altitude of 11.6 km, with a spectral resolution of 0.18 cm^{-1}. Appearance of the feature only on day records suggests a solar origin, and the fact that it is detected in both solar absorption and emission indicates that the source must be very large. The observed phenomena may have important consequences for the correct interpretation of far infrared atmospheric and astronomical data. Further measurements are in progress. (UK)

30767 DIFFUSION OF CHARGED PARTICLES IN A RANDOM MAGNETIC FIELD. Earl, J.A. (Department of Physics and Astronomy, University of Maryland, College Park). Astrophys. J. 180: No. 1, 227-238 (15 Feb 1973).

When charged particles move in a random magnetic field superposed upon a relatively large constant field, their pitch-angle distribution can be calculated to any desired precision by an iterative approximation procedure. Improved knowledge of the pitch-angle distribution and of the characteristic time for relaxation of anisotropy leads to an accurate expression for the coefficient of diffusion parallel to the mean field. (auth)

30768 COSMIC RAYS IN A RANDOM MAGNETIC FIELD: BREAKDOWN OF THE QUASILINEAR DERIVATION OF THE KINETIC EQUATION. Kaiser, T.B. (Department of Physics and Astronomy, University of Maryland, College Park); Jones, F.C.; Birmingham, T.J. Astrophys. J. 180: No. 1, 239-245 (15 Feb 1973).

We consider the problem of deriving a kinetic equation for the cosmic-ray distribution function in a random magnetic field. A model is adopted which is mathematically simple but which contains the essential physics. We investigate the perturbation expansion upon which the quasilinear treatment employed by previous authors is based. As pointed out by Klimas and Sandri, the existence of resonant particles causes the breakdown of the adiabatic approximation frequently used in this theory. We find further that resonant particles cause a general secular growth of higher-order terms in the expansion which invalidates the entire perturbative approach. (auth)

30769 MEASUREMENT OF THE ABSOLUTE VERTICAL INTEGRAL AND DIFFERENTIAL COSMIC-RAY SINGLE-MUON FLUX AT 3.6 GeV AND A MEASUREMENT OF THE SHOWERLESS PENETRATING PARTICLE-PAIR FLUX ABOVE 3.6 GeV. Kanofsky, A. S. (Lehigh Univ., Bethlehem, PA); Colter, P. C. Nuovo Cim.; 17B: No. 1, 219-228(11 Sep 1973).

The absolute vertical integral and differential cosmic-ray single-muon flux at 3.6 GeV was measured. The apparatus consisted of two 100 in. high iron absorbers placed between large counter arrays. The iron absorbers could be magnetized with current-carrying coils wrapped around term. The differential flux was obtained from flux measurements at different magnetic-field values. Adjacent counters were used to correct the data for cosmic-ray showers and to provide parallel counter telescopes to look for penetrating pairs due to μ's or quarks. The measured integral flux at 3.6 GeV was $(1.83 \pm 0.4) \cdot 10^{-3}/cm^2 \cdot sr \cdot s$, and the differential flux was $(1.28 \pm 0.25) \cdot 10^{-3}/cm^2 \cdot sr \cdot GeV \cdot s$. The showerless μ-pair flux was measured to be $(0.58 \cdot 10^{-6} \pm 0.58 \cdot 10^{-5})/cm^2 \cdot sr \cdot s$ for pairs between 0 and 30 in. apart, and $(1.68 \cdot 10^{-6} \pm 1.68 \cdot 10^{-5})/cm^2 \cdot sr \cdot s$ for pairs between 30 and 60 in. (auth)

30770 ORIGIN OF STEP IN LEEDS COSMIC RAY SPECTRUM. O'Brien, K. (Health and Safety Lab., New York). Nature (London) Phys. Sci.; 244: No. 136, 88-89(6 Aug 1973).

It was found that a sea level cosmic-ray spectrum measured at Haverah Park (elevation 240 m) showed a pronounced "step" near 10 TeV and it has been speculated that this was either due to the onset of a new reaction or associated with some feature of the primary spectrum. In either case the "step" would be at a lower energy at sea level than the feature which initially gave rise to it, because of the inelastic nature of hadron–nucleus collisions and the thickness of the atmosphere. The origin of the "step" is discussed. (UK)

30771 CHONDRITES WITH PECULIAR RARE-EARTH PATTERNS. Nakamura, N.; Masuda, A. (Tokyo Univ.). Earth Planet. Sci. Lett.; 19: No. 4, 429-437(Aug 1973).

Rare-earth elements and Ba in Khohar, Abee, Indarch, Atlanta, Jajh deh Kot Lalu, and Nakhla were determined accurately by isotope dilution technique; for Atlanta only, Fe(total), Mg, and Ca were also determined. Khohar shows in two aliquants a strikingly large, positive anomaly for Ce. A fragment of Abee is outstanding in having a large positive Yb anomaly and a zigzag RE pattern. It is considered that the Yb anomaly is not necessarily associated with the zigzaggedness in question. Anyway, these facts corroborate previous observations that abundances of Ce and/or Yb could be sometimes anomalous in meteoritic and lunar

materials. Atlanta also has a significant negative Eu anomaly, similar to the Eu depletions observed in lunar basalts and Ca-poor achondrites by other workers. Besides, this enstatite chondrite has a RE pattern which indicates that this meteorite is cumulate-type (solid-type) material separated perhaps from a considerably fractioned melt. Accordingly, it is suggested that it is not always appropriate to classify this type II enstatite chondrite as "chondrite". Two fragments from Abee and Atlanta show different RE patterns. It is also observed that Ba abundances are sometimes sporadically and irregularly high. (auth)

30772 ARGON IN APOLLO 15 GREEN GLASS SPHERULES (15426): $^{40}Ar-^{39}Ar$ AGE AND TRAPPED ARGON. Podosek, F. A.; Huneke, J. C. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 19: No. 4, 413-421(Aug 1973).

The results of thermal-release argon analyses of neutron-irradiated green glass spherules separated from lunar sample 15426 are reported. The gas-retention age, as determined by the $^{40}Ar-^{39}Ar$ method, is $(3.38 \pm 0.06) \times 10^9$ yr. This age is similar to those of local mare basalts and distinct from the ages of Appenine Front samples recovered from the same region as 15426. Trapped argon is present in near-surface regions of the spherules, and can be resolved into at least two components requiring separate origins, a shallow (0.1 μ) component with $^{40}Ar/^{39}Ar \geq 30$, and a deeper (2 μ) component with $^{40}Ar/^{36}Ar = 2.9$. The ratio of trapped ^{40}Ar to ^{36}Ar is higher than found in any lunar soil and suggests that the trapped gas was implanted early in the spherules' history. The cosmic-ray exposure age is 300 my. (auth)

30773 INTERPLANETARY RADIAL GRADIENTS OF GALACTIC COSMIC RAY PROTONS AND HELIUM NUCLEI: PIONEER 8 AND 9 MEASUREMENTS FROM 0.75 TO 1.10 AU. Webber, W.R.; Lezniak, J.A. (Physics Department, University of New Hampshire, Durham, New Hampshire, 03824). J. Geophys. Res. 78: No. 13, 1979-2000 (1 May 1973).

We report measurements of the radial interplanetary cosmic ray gradient made with cosmic ray instruments aboard the Pioneer 8 and 9 spacecraft. The time period covered in these studies is from January 1968 to June 1969. During this time the radial separation of these two spacecraft varied from 0.75 to 1.10 AU from the sun. This study includes detailed measurements of the differential spectra and gradients of protons and helium nuclei from 2 to 1200 Mev/nucleon. The differential gradient for each species is observed to go through a broad maximum of $\sim$50%/AU at energies corresponding to $\sim$1 bv rigidity, decreasing at both lower and higher rigidities. The proton and helium nuclei gradients are small (20%/AU) down to the lowest energies we measure. Above $\sim$1 by the measured gradients are consistent with the 'force field' gradients $G_R = CV/K$, where C, the Compton–Getting factor, is directly determined from the existing primary spectrum. (K is the diffusion coefficient.) Below 1 bv but above $\sim$15 Mev/nucleon energy the gradient that is observed can be explained by the decreasing value of C in the expression for G_{FF}. At still lower energies, even though the Compton–Getting factor C increases suddenly because of the low-energy turn up in the proton and helium nuclei spectrum, no corresponding increase in the radial gradient is observed. (auth)

30774 THE COSMIC γ-RAY SPECTRUM BETWEEN 0.3 AND 27 MEV MEASURED ON APOLLO 15. Trombka, J.I. (Goddard Space Flight Center, Greenbelt, Maryland); Metzger, A.E.; Arnold, J.R.; Matteson, J.L.; Reedy, R.C.; Peterson, L.E. Astrophys. J. 181: No. 3, 737-746 (1 May 1973).

The spectrum of the total (diffuse and discrete sources) cosmic γ-ray background over the 0.3–27 MeV range has been measured with an uncollimated NaI(Tl) scintillation counter 7.0 cm in diameter $\times$7.0 cm long located on a boom 7.6 m from the Apollo 15 service module. Data on cosmic γ-rays were taken during Trans–Earth coast at various boom extensions, detector gains, and with the plastic anticoincidence scintillator enabled and disabled. The energy–loss spectrum at full extension with the anticoincidence enabled, corrected for monochromatic spacecraft γ-rays, is 0.18 counts $(cm^2\ s\ MeV)^{-1}$ at 1 MeV, in agreement with previous measurements on the Ranger 3 and the ERS–18. At 5 MeV, the Apollo measurement of 7×10^{-3} counts $(cm^2\ s\ MeV)^{-1}$ is about a factor of 5 below that determined from the ERS–18. Corrections for line contributions and spacecraft continuum at higher energies give a steep equivalent photon spectrum with a broad feature in the 1–3 MeV region. This flattening can be reduced (but not eliminated) with an estimated correction for spallation effects in the detector, leaving a spectrum which we interpret as a maximum estimate to the true cosmic photon spectrum in the 0.3–27 MeV range. At 3 MeV this limit is a factor of 3 and at 27 MeV a factor of 10 above a power law which extrapolates from measurements below 1 MeV. We have also measured a flux of 0.03 ± 0.015 photons $(cm^2\ s)^{-1}$ at 0.51 MeV which may be mostly of local origin. (auth)

30775 TRANSITION RADIATION IN ASTROPHYSICS. Yodh, G.B.; Artru, X. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park); Ramaty, R. Astrophys. J. 181: No. 3, 725-736 (1 May 1973).

Transition radiation produced by relativistic electrons traversing cosmic grains is investigated as a possible source of celestial X-rays. The detailed theory of transition radiation including the formation–zone effect is used to calculate the X-ray emissivity in interstellar space. It is found that the largest contribution of transition radiation to the observed X-ray emission from the galactic disk is at about 2 keV where less than about 0.3 percent of the observed emissivity is due to transition radiation. At higher energies transition radiation is strongly suppressed by the formation–zone effect, while at lower energies the observed emissivity increases much faster with decreasing energy than does transition radiation. Transition radiation is also compared with bremsstrahlung, synchrotron emission, and Compton scattering. The comparison with synchrotron emission and bremsstrahlung relates X-ray production by transition radiation to radio emission and $\sim$100–MeV γ-ray production, respectively. Using observed upper limits on radio and γ-ray fluxes, we conclude that neither the galactic center nor Seyfert nuclei can be important transition radiators. Compton scattering, on the other hand, competes with transition radiation; i.e., for electrons of given energies both these mechanisms produce photons of approximately the same energies. It is found that for grain opacities as deduced from optical observations, Compton scattering of 2.7° K universal blackbody photons in interstellar space will be a more important source of $\gtrsim$1 keV X-rays than transition radiation. (auth)

30776 INTERPLANETARY SCINTILLATIONS OF COSMIC RAYS. Owens, A.J.; Jokipii, J.R. (Downs Laboratory of Physics, California Institute of Technology). Astrophys. J. Lett. 181: No. 3, L147-L150 (1 May 1973).

Statistically significant broad–band fluctuations of "scintillations" in the high–energy ($T\sim1$ GeV) cosmic–ray flux observed by neutron monitors are interpreted. A mechanism by which interplanetary magnetic–field fluctuations induce cosmic–ray scintillations is presented and shown to be in quantitative agreement with observation. (auth)

30777 RELATIVISTIC SHOCK HYDRODYNAMICS. McKee, C.R.; Colgate, S.A. (New Mexico Institute of Mining and Technology, Socorro). Astrophys. J. 181: No. 3, 903-938 (1 May 1973).

The special–relativistic equations for a perfect fluid are differenced in characteristic form. Since information concerning the state of a fluid is propagated along the characteristic directions, the differencing procedure preserves a fundamental property of the hydrodynamic equations. Shocks are calculated using an energy Lagrange frame where energy fractions become a coordinate. Since numerical zones are attached to surfaces of constant energy, they move so as to conserve the total energy outside a surface and hence strong shocks appear stationary in this frame. The jump conditions across the shock can be enforced directly, so the need for an artificial viscosity to spread the shock over several mass Lagrange zones is eliminated. The result is an order–of–magnitude reduction in computation for equivalent accuracy. On the other hand, the differencing of the equations in characteristic form using a mass Lagrange frame is particularly well suited to the problem of expansion of a relativistic fluid into vacuum. Examples are given of calculations of shocks and expansions that agree in detail with analytical solutions. (auth)

30778 COMPONENT OF PRIMITIVE NUCLEAR COMPOSITION IN CARBONACEOUS METEORITES. Clayton, R. N. (Univ. of Chicago); Grossman, L.; Mayeda, T. K. Science; 182: No. 4111, 485-488(2 Nov 1973).

The oxygen of anhydrous, high-temperature minerals in carbonaceous meteorites is strongly depleted in the heavy stable isotopes ^{17}O and ^{18}O. The effect is the result of nuclear rather than chemical processes and probably results from the admixture of a component of almost pure ^{16}O. This component may predate the solar system and may represent interstellar dust with a separate history of nucleosynthesis. (auth)

30779 INTERPLANETARY SHOCK WAVES AND COSMIC RAYS. Dorman, L. I. Comments Astrophys. Space Phys.; 5: No. 3, 67-74(1973).

A complete model of galactic cosmic-ray interaction with interplanetary shock waves is considered. The model includes the following factors: (1) cosmic-ray gas compression before and behind a shock wave; (2) particle acceleration when reflected from the wave forefront and deceleration when reflected from the near front; (3) finite dimensions and form of the shock wave; (4) diffusive particle propagation before and behind the wave; and (5) appearance of an additional cosmic-ray anisotropy. (WDM)

30780 MEASUREMENT OF COSMIC-RAY MUON CHARGE RATIO AT SEA LEVEL BETWEEN ENERGIES OF 10 AND 1500 GeV. Burnett, T. H.; LaMay, L. J.; Masek, G. E.; Maung, T.; Miller, E. S.; Ruderman, H.; Vernon, W. (Department of Physics, University of California, San Diego, La Jolla, California 92037). Phys. Rev. Lett. 30: No. 19, 937-940 (7 May 1973).

We have measured the cosmic-ray muon charge ratio, μ^+/μ^-, from 10 GeV to 1.5 TeV with a sea-level magnetic spectrometer at eight different zenith angles between 0° and 90°. The data are consistent with a constant charge ration between 50 GeV and 1.5 TeV, in agreement with the predictions of the scaling hypothesis. Assuming the charge ratio to be constant, we obtain its value as 1.261 ± 0.009. (auth)

30781 PRELIMINARY PIONEER-10 INTENSITY GRADIENTS OF GALACTIC COSMIC RAYS. McKibben, R.B.; O'Gallagher, J.J.; Simpson, J.A.; Tuzzolino, A.J. (Enrico Fermi Institute, University of Chicago). Astrophys. J. Lett. 181: No. 1, L9-L13 (1 Apr 1973).

Selected data from the University of Chicago charged-particle telescope on the Pioneer-10 spacecraft bound for Jupiter have been examined and compared with data from the University of Chicago charged-particle telescopes on the Earth satellites IMP-5 and IMP-6 at 1 a.u. to derive a preliminary integral intensity gradient for relativistic galactic protons and helium nuclei. The preliminary value obtained is (4.5 ± 1.0) percent per a.u. over the radial range 1-2.8 a.u. Preliminary differential gradients also have been obtained for the energy range 29-67 MeV per nucleon. These gradients are (1.5 ± 9) percent per a.u. and (-11 ± 13) percent per a.u. for protons and for helium, respectively, over the radial range 1-2.6 a.u. (auth)

30782 COSMIC-RAY MUON INTEGRAL INTENSITY MEASUREMENT UNDER WATER. Davis, H.F. (Department of Physics, Oregon State University, Corvallis, Oregon 97331); Learned, J.G. Phys. Rev. D 8: No. 1, 8-12 (1 July 1973).

The cosmic-ray muon integral intensity ($E_{\mu\text{-threshold}} \geq 1$ GeV/c) was measured under water with a detector of small angular aperture (6.5° full width at half maximum). The motivation of the work was to check the range-energy relation for muons under a medium, water, whose properties are very well known and whose atomic properties (Z, Z^2/A) are significantly different from "rock" used in underground measurements. The ratio of these measured relative muon intensities, converted to equivalent depths of standard rock, to those measured under rock and converted to standard rock, for 50 hg cm$^{-2} \leq d \leq$1000 hg cm^{-2} of equivalent standard rock, is 1.09 ± 0.06. This measurement shows that the range-energy interactions of muons are consistent between "rock" and water for $E_\mu \leq 240$ GeV. (auth)

Stars

30783 (CONF-730301-P2, pp 1083-1092) PHOTODISINTEGRATION AND NUCLEOSYNTHESIS IN STARS. Arnett, W. D. (Univ. of Texas, Austin). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

An overview of recent ideas is presented concerning stellar evolution, nucleosynthesis, and the fate of stars. Emphasis is placed on the nuclear aspects, especially nuclear photodisintegration which for purposes of this review means processes having a photon in either the entrance or the exit channel. (auth)

30784 APPARENT DISCONTINUITY IN THE PROPERTIES OF GIANTS OF THE DISK POPULATION. Evans, T. L. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 1P-2P(1973).

The finding by Hartwick & Hesser (Publ. Astr. Soc. Pacif.; 84: 813(1972)) that giant stars in 47 Tucanae are 1.5m brighter at given B-V than field giants of similar metal content may result from errors in the distance modulus of 47 Tucanae and in the absolute magnitudes adopted for the field stars. (auth)

30785 5 GHz EMISSION FROM β PERSEI. Pooley, G. G.; Ryle, M. (Cambridge Univ., Eng.). Nature (London); 244: No. 5414, 270-272(3 Aug 1973).

The triple star system β Persei (Algol) is an erratic radio source having occasional periods of activity lasting for several days, and it has been suggested that the emission results from mass transfer between Algol A and B, the components of the 2.8 d. eclipsing binary. Observations at 5 GHz are reported, made between June 1972 and February 1973. On most occasions the flux density was measurable, but was usually too small for astrometric purposes. The long term variation in flux density is shown graphically. Periods of intense activity lasted for a few days, separated by intervals of many days during which the flux density remained at a few per cent of that during the active periods; no periodic behaviour was observed. During the flare of July 11, 1972 the flux density attained a value (0.65 fu) more than twice that observed on any other occasion. It seems necessary to suppose that the radiation is generated in the vicinity of Algol AB, or the companion Algol C. In an attempt to distinguish between these two alternatives the radio position was measured, and this suggested that the emission is associated with Algol AB. Information was obtained on the size of the source, and it is concluded that the emission region is normally at least two or three times larger than either Algol A or B, which have sizes $\sim 2 \times 10^9$ m. No clear distinction could be made between various mechanisms for exciting the plasma. (UK)

30786 CRYSTALLIZATION DENSITY OF COLD DENSE NEUTRON MATTER. Schiff, D. (Paris Univ., Orsay, France). Nature (London) Phys. Sci.; 243: No. 130, 130-133(25 Jun 1973).

Matters relating to the question of the state, liquid or solid, in which matter exists in the core of neutron stars are discussed. The density and pressure at which "cold" neutrons would solidify was predicted by Anderson and Palmer (Nature Phys. Sci, 231: 145 (1971)) by scaling the experimental density and pressure at which ^{3}He and ^{4}He solidify at zero temperature. The chief source of uncertainty in this prediction is that neutrons in dense neutron matter show a much more "quantum-like" behaviour than He atoms in liquid He. The present author determines the density and pressure at which neutrons interacting through the Reid potential solidify, by making use of a fermion version of the quantum perturbation method recently developed by Kalos and others for the ground state of any boson system interacting through a sufficiently steep potential. He finds a solidification density of $(2.9 \pm 0.5) \times 10^{15}$ g/cm^3 and a solidification pressure of $(4.7 \pm 1) \times 10^{30}$ atm, the chief source of uncertainty probably being the oversimplified description of the neutron-neutron interaction by a simple central potential. The mean energy per neutron at solidification is found to be 800 MeV. It is concluded that the real difficulty in the problem of dense neutron matter lies more in the two body problem (description of the neutron-neutron interaction) than in the many body problem. (UK)

30787 PHOTOMETRY OF HD 153919 = 2U 1700-37. Penny, A. J. (Royal Greenwich Observatory, Hailsham, Eng.); Olowin, R. P.; Penfold, J. E.; Warren, P. R. Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 7P-12P(1973).

UBVJHKL photometry of HD 153919 is presented. The star is a variable with a period of 3.4120 days, equal to the x-ray period. The variation has two minima of equal depth but of differing shape. One minimum is coincident with the x-ray occultation. There is an infrared excess. The implication of these observations is discussed. (auth)

30788 SPECTROSCOPY OF HD 153919 (= 2U 1700-37). Hutchings, J. B. (Dominion Astrophysical Observatory, Victoria, B. C.); Thackeray, A. D.; Webster, B. L.; Andrews, P. J. Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 13P-18P(1973).

Radial velocities of He II 4541 (absorption) and He II 4686 (emission) in the 06f star HD 153919 confirm the star as the occulting body of the x-ray source 2U 1700-37 with the period 3.412 days (1973). A large scatter may be due to the x-ray source passing through the atmosphere of the primary. The mass of the secondary is estimated to be 2.4 $M_\odot$ on the assumption of 35 $M_\odot$ for the primary. (auth)

30789 HD 187399: A BINARY WITH CASE B MASS-EXCHANGE. Hutchings, J. B.; Redman, R. O. (Dominion Astrophysical Observatory, Victoria, B. C.). Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 209-217(1973).

Recent coudé spectroscopy of HD 187399 is reported and the orbital elements of the single-lined binary redetermined. It is suggested that the primary fills its Roche lobe and loses mass at periastron, and that the system corresponds to a case B of mass-exchange. The secondary appears to be more massive and observationally undetectable. The possibility of its being a black hole is discussed. (auth)

30790 HD 173219: A PERIODIC Be STAR. Hutchings, J. B.; Redman, R. O. (Dominion Astrophysical Observatory, Victoria, B. C.). Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 219-227(1973).

Spectroscopic observations at high dispersion are reported which reveal a period of 58.39 days in the large velocity variations of this star. Velocity amplitudes derived from different lines vary widely, but the other orbital elements agree well. The spectrum has numerous peculiarities, some of which appear to change with phase. The main features suggest a spectral type of B2 Ib. Possible shell configurations are discussed and it is speculated that the invisible high mass companion may be a black hole. (auth)

30791 SOLIDIFICATION OF A CARBON-OXYGEN PLASMA. Loumos, G.L.; Hubbard, W.B. (Department of Astronomy, University of Texas at Austin). Astrophys. J. 180: No. 1, 199-206 (15 Feb 1973).

Numerical results are presented for the high-density liquid-solid phase transition for a two-component plasma consisting of equal numbers of carbon and oxygen; however, a generalization can be made for any

composition exhibiting a charge ratio of 3 to 4 with appropriate scaling. For the CO system, a melting temperature of $T_m=3.19\times10^7$ °K at 10^9 g cm^{-3} is obtained, with error bars extending from 2.73×10^7 to 3.83×10^7 °K. Comparison with the one-component plasma of Brush, Sahlin, and Teller is also made. (auth)

30792 EVOLUTION OF LOW-MASS STARS. V. MINIMUM MASS FOR THE DEUTERIUM MAIN SEQUENCE. Grossman, A.S. (Erwin W. Fick Observatory, Iowa State University); Graboske, H.C. Astrophys. J. 180: No. 1, 195-198 (15 Feb 1973).

An evolutionary sequence of stellar models has been calculated to determine the minimum mass and maximum time duration of stars on the low-mass end of the deuterium main sequence. The chemical composition chosen is (X=0.68, Y=0.29), with the terrestrial value $X_D=1.9\times10^{-4}$, and l/Hp=1. Evolutionary tracks have been calculated for 0.008, 0.01, 0.012, 0.015, and 0.02 $M_\odot$. The mass limit for the deuterium main sequence is at or slightly below 0.012 $M_\odot$, and the maximum time duration is 7.5×10^7 years. The luminosity of the minimum-mass deuterium-burning model is very slightly higher than that of the minimum-mass hydrogen-burning model, with a T_e smaller by 500° K. The low-mass ends of the deuterium and hydrogen main sequences thus bracket the observations of Van Biesbroeck's star and W359. Stars with masses $M\lesssim0.01$ $M_\odot$ enter strong deuterium-burning phases, but do not stabilize in a main-sequence configuration. (auth)

30793 THE VERIFICATION OF MINARDI'S INSTABILITY CRITERION FOR NONHOMOGENEOUS SELF-GRAVITATING EQUILIBRIA. Cuperman, S.; Tzur, I. (Department of Physics and Astronomy, Tel-Aviv University, Ramat Aviv, Tel-Aviv, Israel). Astrophys. J. 180: No. 1, 181-193 (15 Feb 1973).

Results of numerical integrations of the time-dependent Vlasov and Poisson equations are presented in support of Minardi's linear instability criterion for inhomogeneous non-Maxwellian Vlasov equilibria. (auth)

30794 ON THE OSCILLATIONS AND STABILITY OF RAPIDLY ROTATING STELLAR MODELS. III. ZERO-VISCOSITY POLYTROPIC SEQUENCES. Ostriker, J.P. (Princeton University Observatory, Princeton, New Jersey); Bodenheimer, P. Astrophys. J. 180: No. 1, 171-180 (15 Feb 1973).

The frequencies of oscillation of the lowest "radial" and nonradial modes are calculated for differentially rotating, axisymmetric, stellar models along the generalized polytropic sequences discussed in the preceding paper. The stability of the models to nonaxisymmetric perturbation is discussed and compared with the properties of the classical Maclaurin spheroids. As in the case of the Maclaurin sequence, the models become neutrally stable to a nonaxisymmetric mode when $t\equiv|T/W|$, the ratio of kinetic to potential energy, reaches 0.14. Beyond this point the models are expected to be secularly unstable if dissipative processes are present. Also, when $t\gtrsim0.25$, the models are dynamically overstable to the same mode, which transforms them into triaxial configurations. It is particularly significant that these critical values of t are found to be practically independent of polytropic index and distribution of angular momentum. The critical γ_c (below which stars are unstable to the pulsation mode) declines from 4/3 to approximately 1.23 for models near the point of bifurcation for n=1.5, and to 1.28 for n=3. Some astrophysical consequences of the numerical results are discussed, with applications made to the problem of fission, the stability of close binaries, the possible existence of triaxial stars, and the stability of supermassive stars. (auth)

30795 RAPIDLY ROTATING STARS. VIII. ZERO-VISCOSITY POLYTROPIC SEQUENCES. Bodenheimer, P. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz); Ostriker, J.P. Astrophys. J. 180: No. 1, 159-169 (15 Feb 1973).

The sequence of uniformly rotating (Maclaurin) spheroid of uniform density is generalized to the case of sequences of axisymmetric centrally condensed configurations, with fixed distributions of angular momentum. Numerical results are presented for such sequences of differentially rotating polytropes with indices 0, 3/2, and 3, and differing assumptions regarding the distribution of angular momentum. The generalized polytropic sequences bear close resemblance to the Maclaurin sequence, in most respects. In particular, the generalized sequences do not terminate, they do not "rotationally eject" matter, but they do reach points of bifurcation beyond which secular stability probably ceases. (auth)

30796 THE INTERSTELLAR REDDENING LAW IN THE ULTRAVIOLET DEDUCED FROM FILTER PHOTOMETRY OBTAINED BY THE OAO-2 SATELLITE. Laget, M. (NASA, Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 180: No. 1, 61-70 (15 Feb 1973).

Filter photometry has been obtained of 16 B0 stars at 10 effective wavelengths in the range λλ4250-1430 Å. The wavelength dependence of the interstellar reddening law, deduced from a least-squares fit of the observed values to the reddening line at each band, is found in satisfactory agreement with that derived by Bless and Savage. Toward the shorter wavelengths the increase of the computed probable error of the slope of the mean reddening line suggests that large fluctuations in the law may occur from star to star. Similar computations, separating main-sequence stars and supergiants, indicate that the large fluctuations of the law appear to be well related to the luminosity of the stars; the supergiants show systematically less extinction, this deficiency becoming large toward the far-ultraviolet. The small number in the sample, however, does not allow a general conclusion to be drawn. At 1550 Å supergiants are found to be 0.9 mag fainter and giants about 0.3 mag fainter than main-sequence stars relative to their V-magnitude. (auth)

30797 COMPARISON OF CELESCOPE MAGNITUDES WITH MODEL-ATMOSPHERE PREDICTIONS FOR A, F, AND G SUPERGIANTS. Parsons, S.B. (Warner and Swasey Observatory, Case Western Reserve University); Peytremann, E. Astrophys. J. 180: No. 1, 71-79 (15 Feb 1973).

Ultraviolet data from OAO-2 are analyzed with respect to three different sets of model atmospheres. We find that (1) A0-A2 supergiants are in good agreement with model atmospheres; (2) late A and early F supergiants are fainter than predicted, requiring very heavy line absorption and/or additional continuous opacity sources; and (3) the two G0 supergiants are considerably brighter than expected, implying a B-type companion in one case (HR 4511) and chromospheric emission in the other (HR 2786). (auth)

30798 COOLING EFFECT OF CO IN STELLAR ATMOSPHERES. Johnson, H.R. (Indiana University, Bloomington). Astrophys. J. 180: No. 1, 81-89 (15 Feb 1973).

We investigate the effects of the CO infrared opacity (1.5-5.0 μ) in stellar atmospheres. For model atmospheres with effective temperatures between 3000° and 5000° K, CO lowers the boundary temperature by amounts up to ≈1000° K and usually back-warms the photosphere slightly. This cooling effect is smaller for dwarfs than supergiants of the same temperature and its quite strongly affected by the amount of atomic line blanketing. Evidence for this CO cooling seems to be provided by the value of the temperature minimum deduced for Arcturus. We speculate on the possible application of these results to the temperature minimum of the Sun and to grain formation in cooler stars. (auth)

30799 THE INFLUENCE OF DUST UPON THE DYNAMICS AND THERMAL STABILITY OF PLANETARY NEBULAE. Hunter, J.H. Jr. (Department of Astronomy, University of South Florida, Tampa). Astrophys. J. 180: No. 1, 99-105 (15 Feb 1973).

It is argued that no significant amount of dust could have existed in a planetary nebula until the radius of the shell exceeded $\approx10^{14}$ cm. Otherwise, radiation force acting on the grains would accelerate the shell to speeds well in excess of the observed expansion rates. However, if grain formation occurs before the radius of the shell is $\approx10^{17}$ cm, the bulk of the nebula will be shielded from the ultraviolet radiation from the central star. Then, conditions would be favorable for the development of thermal instabilities, which could result in the formation of the inhomogeneities observed in planetary nebulae. (auth)

30800 HIGH-FREQUENCY OPTICAL VARIABLES. I. G61-29. Richer, H.B.; Auman, J.R.; Isherwood, B.C.; Steele, J.P.; Ulrych, T.J. (Department of Geophysics and Astronomy, University of British Columbia, Vancouver, Canada). Astrophys. J. 180: No. 1, 107-114 (15 Feb 1973).

Observations and analysis of the peculiar object G61-29 are presented. It is shown that when the star is most active a strong optical periodicity near 105 seconds develops, weakens, and shifts to lower frequency, indicating that the mechanism is probably plasma oscillations. A model for G61-29 is derived in which it is suggested that this object should be an easily detected X-ray source. (auth)

30801 EMISSION-LINE STARS IN THE CHAMAELEON T ASSOCIATION. Henize, K.G. (Lindheimer Astronomical Research Center, Northwestern University); Mendoza V., E.E. Astrophys. J. 180: No. 1, 115-119 (15 Feb 1973).

Objective-prism spectrum surveys conducted in 1962 and in 1970 reveal 32 stars showing Hα emission in the region of the Chamaeleon T association. Twelve of these stars show variations in either continuum intensity or Hα intensity. The magnitudes range from V=8.4 (spectrum B9.5 Ve) to approximately 16. Slit spectra have been obtained of 13 stars. Seven show classifiable absorption-line spectra, four show completely veiled continua, and two lack bh.e spectra. The veiling is strongly correlated with variability. The second brightest emission-line star, CD-76°486, shows significant spectrum variations between 1962 and 1972. (auth)

30802 HIGH-SPEED PHOTOMETRY OF Z CAMELOPARDALIS. Robinson, E.L. (Department of Astronomy, University of Texas at Austin). Astrophys. J. 180: No. 1, 121-141 (15 Feb 1973).

High-speed photometry of Z Cam shows that its light curve bears a strong resemblance to the light curves of U Gem and VV Pup. Strong flickering is always present in Z Cam and has an amplitude correlated with the position of Z Cam in its eruption light cycle. Z Cam does not show eclipses. Low-amplitude sinusoidal periodicities have been found in the light curve during eruptions with periods between 16 and 19 seconds. A model of Z Cam is constructed whose major new feature is a bright spot on the disk of gas around the white dwarf. The bright spot contributes at least 20 percent of the total light of Z Cam during minima, and is the source of the flickering. The periodicities are interpreted as nonradial pulsations of the white dwarf. On the basis of the pulsations, it is shown that the white dwarf must be the seat of the eruptions. During the eruption the disk of gas increases in radius. (auth)

30803 SEARCHING FOR TECHNETIUM IN Ap STARS. Davis, D. N. (California Inst. of Tech., Pasadena). Astrophys. Lett.; 14: No. 4, 217-218(1973).

Space-telescope observations of higher resolution are urgently needed in the search for Tc II lines ca. λ2600 Å in Ap stars. Finding technetium in HR 465 would lend support to the proposed identification of promethium therein. (auth)

30804 ARE ACCRETING DA WHITE DWARFS THE PROGENITORS OF DB WHITE DWARFS? Sion, E. M. (Univ. of Pennsylvania, Philadelphia). Astrophys. Lett.; 14: No. 4, 219-220(1973).

On the basis of theoretical arguments, it is shown that DA white dwarfs are unlikely to be progenitors of DB white dwarfs. It is suggested that accretion may be prevented in the DB white dwarfs by a hot corona–stellar wind mechanism. The possible relationship of these objects to the nuclei of planetary nebulae is briefly discussed. (auth)

30805 SELF-SUSTAINED MASS FLOW IN CLOSE BINARY SYSTEMS. Chau, W. Y.; Chia, T. T.; Henriksen, R. N. (Queen's Univ., Kingston, Ont.). Astrophys. Lett.; 14: No. 4, 221-224(1973).

The general conditions for the self-sustenance of mass flow in a close binary system were studied and it was found that, in some cases, the condition becomes one on the rate of mass transfer. Application is made to the System WZ Sagittae and to the recently discovered pulsing binary x-ray sources Cen X-3 and Her X-1. (auth)

30806 SOME EFFECTS OF DELAYED-NEUTRON EMISSION ON R-PROCESS ABUNDANCES. Blake, J. B. (Aerospace Corp., Los Angeles); Schramm, D. N. Astrophys. Lett.; 14: No. 4, 207-211(1973).

Some effects on elemental abundances resulting from delayed-neutron emission during the beta decay back to the valley of stability from the r-process nucleosynthetic path are examined. It is found that delayed-neutron emission results in a skewing of the r-process abundance peaks, with a more rapid falloff on the high mass side and a broader low mass side than would otherwise occur. The location of the maximum is essentially unchanged but the peak is flattened. Skewed peaks are indeed observed in the empirical r-process abundances. Furthermore the reduced odd-even abundance variations observed in the r-process peaks can be due, at least in part, to the smoothing effect of delayed-neutron emission. Delayed-neutron emission does not result in an abundance hump in the rare-earth region. (auth)

30807 GRAIN FORMATION IN THE EXPANDING ENVELOPES OF T TAURI STARS. Nishida, S.; Nakazawa, K. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1152-1165(Apr 1973).

The possibility of the nucleation in the expanding of T Tauri stars was investigated by using the nucleation theory by Becker and Döring. The nucleation time scale τ_n in the gas was investigated assuming that only graphite is condensable. The expansion time scale τ_{exp} of the gas ejected from a T Tauri star was calculated assuming that the gas flow is steady and spherically symmetric. The time scale τ_n was compared with τ_{exp} for $X_c = 10^{-2}$ (X_c is the concentration of carbon by mass) assuming that the gas expands adiabatically, and the mass-loss rate needed for nucleation was found to be larger than those observed in T Tauri stars. This suggests that nucleation around T Tauri stars is rather difficult. (auth)

30808 STRUCTURE AND EVOLUTION OF STELLAR MASSES IN THE RELAXATION PHASE. Talpaert, Y. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 58: 1135-1145(1972). (In French).

Dynamical models related to the clusters structure in the relaxation phase are presented as well as their evolution using a series of equilibrium models of King's type, each one corresponding to a determined central concentration. This study takes into account the cluster limits imposed by the tidal force of the Milky Way and an increasing velocity space anisotropy at greater distances from the center of the system. The introduction of this anisotropy leads to a better fit between the theorical projected density curves and King's empirical curves. However, to reduce the difference between these curves, a mass spectrum was introduced so that the projected densities correspond exactly to the empirical densities. For given masses, escape rates are obtained which remain practically unchanged during evolution. Contrarily to King's equal masses models, where the evaporation is practically the same everywhere, the star loss is the greatest in the central regions. Evaporation times estimations are given for ω Cen and NGC 7789 clusters. (auth)

30809 SHOCK WAVES IN GAS STREAMS IN CLOSE BINARY SYSTEMS OF DWARF STARS. Taranov, V. I. (Kaliningrad State Univ., USSR). Astrophysics (Engl. Transl.); 7: No. 2, 172-176 (1971).

Translated from Astrofizika; 7: No. 2, 295-302(1971).

The behavior of a shock-wave front in gas streams is investigated. It is assumed that energy loss occurs behind the shock-wave front through radiation. It is shown that the shock-wave front executes an oscillatory motion. The dependence of the period and amplitude of the oscillations on the parameters of the system is found. (auth)

30810 POLARIMETRIC AND PHOTOMETRIC OBSERVATIONS OF EV LAC FLARES. Grigoryan, K. A.; Eritsyan, M. A. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 7: No. 2, 177-179(1971).

Translated from Astrofizika; 7: No. 2, 303-306(1971).

EV Lac was observed over a total period of 95 hr. During this time four flares in the blue region of the spectrum were recorded. The brightness curves of the flares are shown. (WDM)

30811 COOLING OF WHITE DWARFS. Seidov, Z. F.; Eminzade, T. A. (Shemakha Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 7: No. 2, 180-182(1971).

Translated from Astrofizika; 7: No. 2, 306-310(1971).

An expression for the cooling time of white dwarfs is obtained which does not depend on the mass. The value of the cooling time is strongly dependent on the choice of chemical composition made for the envelope and star interior. (WDM)

30812 PROBLEM OF ROTATION OF CONFIGURATIONS HAVING A HOMOGENEOUS DISTRIBUTION OF MATTER IN THE GENERAL RELATIVITY THEORY. Arutyunyan, G. G.; Sedrakyan, D. M. (Erevan State Univ.). Astrophysics (Engl. Transl.); 7: No. 2, 150-157(1971).

Translated from Astrofizika; 7: No. 2, 259-270(1971).

The problem of the homogeneous rotation of a model consisting of an incompressible fluid is solved in the quadratic angular-velocity approximation. The internal structure and most important integral parameters of the configurations are calculated. (auth)

30813 SOME CHARACTERISTICS OF THE FLARE ACTIVITY OF UV CETI TYPE STARS. II. Oskanyan, V. S.; Terebizh, V. Yu. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 7: No. 2, 164-171(1971).

Translated from Astrofizika; 7: No. 2, 281-294(1971).

The results of B-color photoelectric observations of stars AD Leo, EV Lac, YZ CMi, and UV Cet carried out in 1967-1970 are discussed. A study of the distribution of the amplitudes, energies, and frequency functions of flares shows that the properties of the first three stars are quite similar. The relative flare luminosity of these stars are approximately the same. The role of observational selection in detecting low-amplitude flares and the problem of determining the absolute flare activity of stars are discussed in detail. (auth)

30814 COOLING AND INTERNAL CHARACTERISTICS OF HOT BARYONIC CONFIGURATIONS. Adzhyan, G. S.; Vartanyan, Yu. L. (Erevan State Univ.). Astrophysics (Engl. Transl.); 7: No. 2, 136-149(1971).

Translated from Astrofizika; 7: No. 2, 237-258(1971).

The internal characteristics and the cooling time of hot baryonic stars with masses 0.64 M and 1.55 $M_\odot$ are discussed. All of the calculations are done within the framework of general relativity theory. It is shown that the temperature of the internal isothermal nucleus is almost a whole order of magnitude greater than the temperature at the onset of degeneracy. This leads to a drastic shortening of the cooling time, in the region of neutrino luminosity, compared to data reported in other investigations. The results of the calculations are presented. (auth)

30815 THEORY OF NONSTATIONARY RADIATIVE TRANSFER FOR ANISOTROPIC SCATTERING. Grinin, V. P. Astrophysics (Engl. Transl.); 7: No. 2, 116-119(1971).

Translated from Astrofizika; 7: No. 2, 203-209(1971).

Nonstationary radiative diffusion in a one-dimensional, aniso-

tropic scattering medium is considered. It is assumed that the mean lifetime of a quantum in the medium is determined by the time interval between two subsequent scatterings. A modification of Sobolev's probability method is used in the case of anisotropic scattering to obtain the intensity of emergent radiation. In the case of a semiinfinite medium the probabilities pj (τ, u, z, λ), j = 1, 2, of the exit of photons from the medium are expressed in terms of the Bessel functions I_0 and I_1. A similarity relation is given which connects the transmission and reflection coefficients σ and ρ for arbitrary x in the interval from 0 to 1 with corresponding quantities for x = ½ (isotropic scattering). (auth)

30816 POLARIZATION OF RADIATION OF FLARE STARS. Grinin, V. P.; Domke, H. (Crimean Astrophysical Observatory, Simferopol, USSR). Astrophysics (Engl. Transl.); 7: No. 2, 120-126(1971).

Translated from Astrofizika; 7: No. 2, 211-222(1971).

The diffuse reflection of light from a point source (flare) by the semiinfinite plane-parallel atmosphere of a cold dwarf is examined. It is assumed that molecular (Rayleigh) scattering and true absorption occur in the atmosphere. The Stokes parameters of the azimuthally averaged reflected radiation are expressed by an H-matrix for the case of Rayleigh scattering. The polarizations of the reflected radiation (P) and the total radiation (including the direct radiation of the (flare) (P_S) are calculated in relation to the cosine μ of the reflection angle and the quantum survival probability λ. The maximum value $P_{S\,max}$ = 4.1% is attained when λ = 1 and μ = 0.3. The wavelength dependence of the polarization P_S is discussed. (auth)

30817 EQUATION OF STATE OF MATTER AT SUPERNUCLEAR DENSITIES. Leung, Y.C. (Southeastern Massachusetts University, North Dartmouth); Wang, C.G. Astrophys. J. 181: No. 3, 895-902 (1 May 1973).

The qualitative features of the equation of state of matter at supernuclear densities are deduced through careful examination of the nature of particle interactions at short distances and by the introduction of an "effective baryon mass spectrum." It is found that the equation of state begins to take on a particularly simple form (the "asymptotic form") at a relatively low matter density of 10^{17} g cm^{-3}. (auth)

30818 RELATIVISTIC STELLAR STABILITY: AN EMPIRICAL APPROACH. Ni, W. (California Institute of Technology, Pasadena, California). Astrophys. J. 181: No. 3, 939-956 (1 May 1973).

The "PPN formalism"—which encompasses the post-Newtonian limit of nearly every metric theory of gravity—is used to analyze stellar stability. This analysis enables one to infer, for any given gravitation theory, the extent to which post-Newtonian effects induce instabilities in white dwarfs, in neutron stars, and in supermassive stars. It also reveals the extent to which our current empirical knowledge of post-Newtonian gravity (based on solar-system experiments) actually guarantees that relativistic instabilities exist. In particular, it shows that (i) for "conservative theories of gravity," current solar-system experiments guarantee that the critical adiabatic index, Γ_{crit}, for the stability of stars against radial pulsations exceeds the Newtonian value of $4/3$: $\Gamma_{crit} = 4/3 + 2KM/R$, K positive and of order unity; this ensures the existence of the "relativistic instability"; (ii) for "nonconservative theories," current experiments do not permit any firm conclusion about the sign of $\Gamma_{crit} - 4/3$; (iii) in the PPN approximation to every metric theory, the standard Schwarzschild criterion for convection is valid. (auth)

30819 A VARIATIONAL PRINCIPLE FOR MAGNETOELASTIC, ROTATING STARS IN GENERAL RELATIVITY. Munn, M.W. (Department of Physics, University of California, Santa Barbara). Astrophys. J. 181: No. 3, 957-976 (1 May 1973).

We show here that an extremal energy variational principle can be formulated which, as conditions for the extremum, reproduces the gravitational field equations, the equation of magnetoelastic equilibrium, and an expression for the angular velocity of the star. The proof is carried out for elastic, rotating stars which contain magnetic fields and is done in the Newtonian theory and in general relativity. (auth)

30820 SOME PROBLEMS OF MEAN FIELD ELECTRODYNAMICS. Krause, F. (Zentralinstitut für Astrophysik Potsdam der Deutschen Akademie der Wessenschaften Berlin, German Democratic Republic); Roberts, P.H. Astrophys. J. 181: No. 3, 977-992 (1 May 1973).

The mathematical structure which describes the evolution of the ensemble average of an electromagnetic field in an electrically conducting fluid in turbulent motion is often called mean field electrodynamics; the theory has significant applications to cosmic magnetism. Recent studies of the theory by Lerche have cast doubt on several earlier conclusions of Steenbeck, Krause, and Rädler, and it is the object of this paper to resolve the major points of conflict. In particular, defects are demonstrated in arguments which led Lerche to assert that isotropic, statistically steady, mirror-symmetric turbulence can regenerate magnetic field in a conducting fluid. Also, a new development of a theory by Krause and Steenbeck is presented which shows that stochastic variations in conductivity do not promote the growth of fields of large wavelength. (auth)

30821 KINEMATIC DYNAMO THEORY. V. COMMENTS ON DIVERSE MATTERS INCLUDING HISTORICAL DEVELOPMENT, ISOTROPIC TURBULENCES, AND EXPANSION TECHNIQUE. Lerche, I. (Enrico Fermi Institute and Department of Physics, University of Chicago). Astrophys. J. 181: No. 3, 993-1002 (1 May 1973).

We show that three of the four major criticisms by Krause and Roberts of our work in turbulent kinematic dynamic theory possess fundamental errors, and are without foundation. We also correct the errors in the historical record of the development of turbulent kinematic dynamo theory presented in their paper. We agree with Krause and Roberts that violation of Bochner's theorem is not a matter to be treated lightly—particularly for velocity turbulence which includes helicity. We demonstrate violation of this theorem for the turbulence used by Steenbeck, Krause, and Rädler (1966) to calculate their "α-effect." We further point out that the ansatz $\langle \delta v \times \delta B \rangle = \alpha B$, so often invoked by Steenbeck, Krause, and Rädler, cannot be correct except under Parker's "short-sudden" approximation. (auth)

30822 HYDROSTATIC EQUILIBRIUM OF HYDROMAGNETIC FIELDS. Yu, G. (Department of Physics, University of Chicago). Astrophys. J. 181: No. 3, 1003-1008 (1 May 1973).

The condition for a hydromagnetic field to be in hydrostatic equilibrium is discussed. It is shown that if the topology of the wrapping pattern of lines of force of a non-force-free field around each other changes along the field, then the configuration cannot be in hydrostatic equilibrium. A general discussion is given, and several special cases are worked out to illustrate the general equilibrium requirement. (auth)

30823 LONG-PERIOD VARIABLES: CORRELATION OF STELLAR PERIOD WITH OH RADIAL-VELOCITY PATTERN. Dickinson, D.F.; Chaisson, E.J. (Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 181: No. 3, L135-L138 (1 May 1973).

The OH radio spectrum seen in variable stars shows two distinct groups of emission features well separated in radial velocity. In this paper we show that the separation is directly proportional to the period. (auth)

30824 CONDITIONS FOR CARBON MONOXIDE VIBRATION-ROTATION LTE IN LATE STARS. Thompson, R.I. (Steward Observatory and Department of Astronomy, Univeristy of Arizona, Tucson). Astrophys. J. 181: No. 3, 1039-1054 (1 May 1973).

Collisional vibration and rotation transition rates are found for carbon monoxide due to H, H_2, He, and electrons. These rates are compared to the radiative rates of transition in carbon monoxide to establish temperature-pressure regions in which vibration-rotation LTE is a good approximation and those regions in which possible non-LTE effects may occur. Comparison of these data with current late-star model atmospheres indicates that possible vibrational non-LTE effects may occur in supergiants, but in all late-star computed atmospheres rotational LTE should be a good approximation. The further question of total molecular LTE is examined and rate equations set up. Rough order-of-magnitude estimates are made on the conditions for total LTE in CO. (auth)

30825 POSITRON-ANNIHILATION RADIATION FROM NEUTRON STARS. Ramaty, R.; Borner, G. (Laboratory for High Energy Astrophysics, Goddard Space Flight Center, Greenbelt, Maryland); Cohen, J.M. Astrophys. J. 181: No. 3, 891-894 (1 May 1973).

Matter accreted on the surfaces of neutron stars consists of energetic particles of a few tens to one or two hundred MeV per nucleon, depending on the neutron-star mass. In addition to the heat, such particles produce nuclear reactions with the surface material. We propose that the recently observed 473±30 keV spectral feature from the galactic center is gravitationally redshifted positron-annihilation radiation produced at the surfaces of neutron stars. The principal observational tests of the model would be the detection of nuclear γ-ray lines from the galactic center. (auth)

30826 HIGH-VELOCITY GAS IN SUPERNOVA REMNANTS. II. SHAJN 147. Silk, J. (University of California, Berkeley); Wallerstein, G. Astrophys. J. 181: No. 3, 799-804 (1 May 1973).

A component of interstellar Ca II at -69 km s^{-1} (with respect to the local standard of rest) has been found in HD 36665, which lies behind the supernova remnant Shajn 147. Using this velocity and the theory of expanding blast waves, we find that the energy released in the initial explosion was $(11\pm5) \times 10^{50} n_0$ ergs (where n_0 is the particle density in the ambient medium) and that the age of Shajn 147 is $(9\pm4) \times 10^4$ years. By comparing the data for Vela XYZ, the Cygnus Loop, and

Shajn 147, we show that these three supernova remnants form a sequence with respect to size, age expansion velocity, excitation, and radio surface brightness. They appear to be similar phenomena observed at different stages of evolution. (auth)

30827 WAVELENGTH SHIFTS AND PROBABLE ISOTOPIC STRUCTURE OF PT II λ4046 IN MERCURY STARS. Dworetsky, M.M.; Vaughan, A.H. Jr. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 181: No. 3, 811-816 (1 May 1973).

Measurements on coudé spectrograms of nine Hg–Pt stars show that Pt II λ4046 is shifted toward longer wavelength by 0.04 to 0.09 Å from the centroid for terrestrial platinum. High-resolution scans made with a Fabry–Perot interferometer show a single exceedingly sharp component in χ Lup A, which probably represents a single heavy isotope. In ϵ CrB two or more heavy isotopes appear to be present. (auth)

30828 LOW-TEMPERATURE FREE-FREE EMISSION: INFRARED EXCESSES IN BE STARS. Milkey, R.W.; Dyck, H.M. (Kitt Peak National Observatory). Astrophys. J. 181: No. 3, 833-839 (1 May 1973).

We discuss the possibility that the infrared emission observed for certain Ae and Be stars may be produced by low temperature free-free processes in the circumstellar region. The problems associated with H^- are discussed and it is shown that, for an optically thin sphere, if H^- free-free processes dominate in the infrared, then one ought to see a strong free-bound continuum in the visible superposed on the stellar continuum. The same arguments can be applied to the electron–proton process. Thus we are left with the fact that a free-free-like opacity fits the observed infrared fluxes but without a corresponding physical picture of the specific mechanism. (auth)

30829 THE LAST BALMER LINE AND Hγ IN MODEL B STARS. Fischel, D.; Klinglesmith, D.A. (Laboratory for Optical Astronomy, Goddard Space Flight Center). Astrophys. J. 181: No. 3, 841-850 (1 May 1973).

Profiles of the last few Balmer lines (H12–H27) and the full profiles of the Hγ line were computed for a grid of hydrogen-line-blanketed model atmospheres. The use of the last hydrogen line and the equivalent width of Hγ provide a quick means of estimating the effective temperature and surface gravity of B stars. Regression curves relating the quantum number of the last hydrogen line to the electron density in the model atmosphere are given. Furthermore, it is shown that the difference in the gravity determination deduced from Hγ equivalent widths using the Edmonds, Schlüter, and Wells formalism and the Griem wing formula is at worst, 0.18 in the common logarithm. (auth)

30830 MODEL ATMOSPHERES FOR BETELGEUSE. Faÿ, T.D.; Johnson, H.R. (Astronomy Department, Indiana University). Astrophys. J. 181: No. 3, 851-864 (1 May 1973).

We present a series of stellar atmospheric models at effective temperatures of 3800° and 3500° K and compare these in detail with scanner observations of Betelgeuse (α Ori, M2 lab). The atmospheres are hydrostatic, flux-constant, LTE atmospheres which include the opacity of H_2O, CO, CN, and atomic line blanketing. To reduce the flux shortward of 6000 Å enough to agree with observations requires either strong atomic line blanketing (or a similar opacity source) or significant reddening, or (likely) both. The visual extinction (an estimate of which depends strongly on the line blanketing, especially in the 1–2 micron region) lies between 0.4 and 2.0 mag. Comparison of our predicted strengths of observed CO and CN features with observations and of our predicted column densities of CO, OH, NH, and H_2O with published column densities suggests that C/H may be less than its solar value by about a factor of 10 and C/O may be less than 0.6 in . Betelgeuse. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 30787, 30891, and 30917.

30831 (AD-756086) ACCURATE POSITIONS OF OH EMISSION SOURCES AT 1665 AND 1667 MHz. Goss, W. M.; Lockhard, I. A.; Fomalont, E. B.; Hardebeck, E. G. (Owens Valley Radio Observatory, Pasadena, Calif.). 1973. Contract N00014-67-A-0094-0019. 21p. NTIS.

Accurate positions of 8 OH emission sources were measured at 1665 and 1667 MHz. The Owens Valley interferometer was used at spacings of 366 and 488 m north–south. Near the continuum sources G45.1 + 0.1 and G45.5 + 0.1, four separate OH emission regions were found. (auth)

30832 (AD-761883) PULSAR ELECTRODYNAMICS. Hinata, S. (Illinois Univ., Urbana. Coordinated Science Lab.). May 1973. Contract DAAB07-72-C-0259. 72p. (R-607; UILU-ENG-73-2209). NTIS.

Thesis.

It is usually assumed that the pulsar atmosphere consists of an open and a closed magnetosphere. There is, however, no generally accepted theory which predicts the boundary between these two regions. Contrary to expectation that the inertial effects would play the crucial role in determining this boundary, the author obtained the critical radius $R_c = \Omega R/C^{-\frac{1}{3}R}$ beyond which the lines of force are open, from the analysis of a corotational atmosphere, which is valid only in the absence of the inertial effects. The author also intends to clarify some of the processes underlying the theory of pair production and subsequent radio wave emission about a pulsar, as set forth by Sturrock. (NTIS)

30833 (AD-762001) SEARCH FOR DEUTERIUM RECOMBINATION LINE EMISSION FROM ORION A. X. Cesarsky, D. A. (Owens Valley Radio Observatory, Pasadena, Calif.). 1973. Contract N00014-67-A-0094-0019. 13p. NTIS.

Line emission from DCN was recently detected in the direction of the Orion Nebula. If DCN and HCN are formed and destroyed at the same rate, the D to H ratio is 0.006. This ratio should result in a detectable recombination line of deuterium. The author searched unsuccessfully for the D92alpha line and placed a limit (D)/(H) > 0.0016. The present results suggest that HCN and its isotope have different rates of formation and destruction. (auth)

30834 OBSERVATIONS OF THE NGC 7538 AT 2.7 AND 5 GHz. Martin, A. H. M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 141-146(1973).

The H II region NGC 7538 has been mapped at 2.7 and 5 GHz with a maximum resolution of 2 arcsec. The source consists of a diffuse region visible optically together with two much more compact components. The latter are close to or coincident with an infrared source, an OH maser, and a region of molecular line emission. (auth)

30835 PHOTOGRAPHIC PHOTOMETRY OF THE PROPOSED OPTICAL CANDIDATE FOR SMC X-1. Butler, C. J.; Byrne, P. B. (Dunsink Observatory, Dublin). Nature (London) Phys. Sci.; 243: No. 130, 136-138(25 Jun 1973).

A variable x-ray source, known as SMC X-1, has been reported in the direction of the wing of the Small Magellanic Cloud, with a regular variation period of 3.8927 d. The nature of the regular variations suggests that the x-ray source is one component of an eclipsing binary system. If this object were in the SMC it would be intrinsically the most powerful binary x-ray source known, and would have the most accurately defined distance of any such source. It has been suggested that SMC X-1 be identified with the star Sanduleak 160. This identification was based on measurements of a number of blue photographic plates, from which it was concluded that this star clearly shows a periodicity of 3.8927 d. Radial velocity measurements have also confirmed SMC membership for Sk 160. The present authors give independent data from photographic material in three colours that indicates that Sk 160 is indeed SMC X-1. (UK)

30836 SPEEDING UP OF PULSING X-RAY SOURCES. Chau, W. Y. (Queen's Univ., Kingston, Ont.). Nature (London) Phys. Sci.; 243: No. 130, 133-134(25 Jun 1973).

It is stated that one of the most intriguing results emerging from observations of x-ray sources is that, in at least two cases, the period of rapid variation is decreasing. Thus, Her X-1 shows a "pulsar" period of ~1.2s decreasing by ~4.5 μs in ~6 months, and Cen X-3 a period of ~4.8s decreasing by ~200 μs in a similar period. Various explanations of this "spinning-up" have been offered. The importance of the effect in any model construction for x-ray sources is emphasized, particularly in view of the conviction by some people that "spinning-up" implies gain of angular momentum and no extraction of rotational energy from the object is thus possible, in contrast with the conventional picture for radio pulsars, in which rotational energy is the ultimate source of the observed luminosity. The author discusses a plausible model based on accretion on a rapidly rotating magnetic white dwarf evolving along the so-called "Jacobi sequence" in which it has the peculiar property of speeding up while losing angular momentum. The idea involves the equilibrium configuration of a uniformly rotating homogeneous fluid mass in the classical theory of hydrodynamics. A difficulty is, however, that the classical theory relates to the case of a homogeneous fluid mass, and this certainly is not the case for a collapsed configuration. (UK)

30837 ROCKET OBSERVATIONS OF THE X-RAY ABSORPTION MEASURE OF SCO X-1. Deerenberg, A. J. M.; Bleeker,

J. A. M.; DeKorte, P. A. J.; Yamashita, K.; Tanaka, Y.; Hayakawa, S. (Univ., Leiden). Nature (London) Phys. Sci.; 244: No. 131, 4-6(2 Jul 1973).

It is stated that discrepancies have occurred in determinations of the amount of absorbing material required to explain the absorption profile of the x-ray spectrum of Sco X-1, and that several suggestions have been put forward to explain these discrepancies. Absorption measures much higher than indicated by radio measurements could be caused by a circumstellar cloud, and to explain low values it has been suggested that the soft x-ray emission of Sco X-1 is variable in time. The results of two rocket observations of Sco X-1, with similar instruments, are described. The first experiment, known as Leinax I, was launched in May 1971, and the second, Leinax II, in May 1972. The observational spectra of both flights are shown, and the method of deriving the x-ray absorption measure described. (UK)

30838 POSSIBLE CANDIDATE FOR LMO X-1. Byrne, P. B.; Butler, O. J. (Dunsink Observatory, Dublin). Nature (London) Phys. Sci.; 244: No. 131, 6-7(2 Jul 1973).

Attention is drawn to the proximity of the radio sources MC76 and 77 to an x-ray source, LMC X-1, reported in the Large Magellanic Cloud south of 30 Doradus. Excluding 30 Doradus, MC76 and 77 are the two brightest radio sources in the LMC at 6 and 11 cm. Optically these sources are identified with the H II regions N160A and N159D, respectively. Both sources lie in a region rich in nebulosity, dust, and young stars, and assuming a distance of 55 kpc to the LMC the linear separation of the two radio sources is 120 pc. (UK)

30839 RECENT ADVANCES IN SHORT-TIME-CONSTANT ASTROPHYSICS. Cavallo, G. (Laboratorio Te.S.R.E., Bologna). Riv. Nuovo Cim.; 3: No. 3, 205-232(1973).

The field of short-time-constant astrophysics is defined to be all astrophysical phenomena (recurrent and sporadic) whose durations are comparable to the interval between observations. A brief outline of the history of the field is given along with a review of the most recent advances in the field of periodic phenomena (pulsars and Cen X-3 type objects). The sporadic phenomena are reviewed, with a discussion of the limits which can be placed on the luminosity of the very-short-lived phenomena. Recent observations of the Cyg X-3 outburst and the 408 MHz variability of radio sources are considered. (WDM)

30840 CORRECTION TO THE POSITION OF GX3 + 1. Janes, A. F.; Pounds, K. A.; Ricketts, M. J.; Willmore, A. P.; Morrison, L. V. (Univ. of Leicester, Eng.). Nature (London); 244: No. 5415, 349(10 Aug 1973).

Earlier x-ray data for GX3 + 1 were checked and a timing error discovered. The new position is shown graphically. (UK)

30841 ACCURATE POSITION OF GX5-1 FROM LUNAR OCCULTATIONS. Hoffman, J. A.; Davison, P. J. N.; Morrison, L. V. (Univ. of Leicester, Eng.). Nature (London); 244: No. 5415, 347-349(10 Aug 1973).

The position of GX5-1 was located more accurately from lunar occultation observation using detectors on board the Earth satellite Copernicus, this being the first of such observations. The observations were made during March to August 1973. Details are given of the technique employed and derivation of the results. A similarity was noted between GX5-1 and GX3+1. Both are bright variable x-ray sources, with low-energy cutoffs, indicating distances of the order of 10 kpc. (UK)

30842 SPECTRA OF RAPIDLY ROTATING OBJECTS. Su, S.; Spector, R.M. (Department of Physics and Astronomy, Wayne State University, Detroit). Astrophys. J. 180: No. 1, 143-157 (15 Feb 1973).

The general problem of the altered spectra to be expected from luminous, rapidly rotating objects is considered. Calculations for the unrealistic, but analytically tractable, case of a delta-function line profile indicate the general result: a marked blueshift and asymmetrical broadening. For the more realistic cases of Briet-Wigner and blackbody spectra, Doppler effects are considered as well as limb darkening. Detailed results are given for typical physical parameters in these cases. The motivation for these investigations provided by pulsars is indicated. (auth)

30843 ROTATING MAGNETOSPHERE: A SIMPLE RELATIVISTIC MODEL. Michel, F.C. (Institute for Theoretical Astronomy, Cambridge, England). Astrophys. J. 180: No. 1, 207-225 (15 Feb 1973).

We solve exactly for the electromagnetic field configuration about an aligned rotating magnetic moment ("star") for the case that there is sufficient plasma about the object to "freeze in" the magnetic fields, but in the limit that the inertia and pressure of the plasma particles can be neglected. These solutions are expected to be valid except near the light cylinder, although there is no mathematical difficulty in solving the resultant equations at or even beyond the light cylinder. The solutions show quantitatively how the field lines make the transition from a closed (dipole-like) to an open configuration and provide a refined estimate of how much magnetic flux is available to open field lines (an important point in many pulsar theories). We find that if a flux Φ from an unperturbed dipole closes outside the light cylinder, then for the perturbed field this flux is increased by a factor of about 1.592. The field lines in the dipole case exhibit a cusp at the light cylinder, and we can calculate the charge density there. This charge density is found to be insufficient to account for coherent radiation of radiofrequency waves from pulsars. (auth)

30844 MOLECULAR CLOUDS IN W49 AND W51. Scoville, N.Z. (Department of Astronomy, Columbia University); Solomon, P.M. Astrophys. J. 180: No. 1, 31-53 (15 Feb 1973).

Radio observations of six molecular lines have been obtained in the W49 and W51 H II region sources as part of an investigation of the physical conditions in molecular clouds and the relationship of these clouds to the H II regions. The principal observations are maps with 4′ spacing of the 6-cm formaldehyde (H_2CO) absorption and strip maps with 1′ spacing of carbon monoxide (CO, $J=1\rightarrow0$) emission at 2.6 mm. A few selected positions were also observed in ^{13}CO and $C^{18}O$ as well as the carbon monosulfide lines (CS, $3\rightarrow2$ and $2\rightarrow1$) at 2 and 3 mm. Seven distinct clouds are found and five of these are associated with or near H II regions. The molecular clouds are all much larger than the H II regions; one near W51 (at 65 km s^{-1}) extends over an area containing at least three H II regions and appears as a self-absorption feature in CO. The mass of three of these molecular clouds is estimated to be at least 10^4–10^5 $M_\odot$, 10 times as great as the ionized regions. Average hydrogen molecule densities, over the entire clouds, are about 200–1000 cm^{-3}; but near the H II regions there are probably compact, high-density ($\gtrsim 10^6$ cm^{-3}) molecular regions which are responsible for the high-excitation lines of CS. The excitation temperature of the 6-cm H_2CO transition in two clouds in the direction of W49A is estimated to be $1.76° \pm 1.2$ °K. The large velocity difference between these clouds and the H II region and the narrowness of the lines suggest that the clouds are dark nebulae and unrelated to W49A; however, there is H_2O maser emission at the velocity of the dark cloud lines suggesting that some of the maser emission may be from foreground objects. (auth)

30845 ARE THE VELA SPEEDUPS EVIDENCE FOR THE FORMATION OF A NEUTRONIC QUANTUM CRYSTAL. Kundt, W. (Univ., Bielefeld, Ger.); Heintzmann, H.; Hillebrandt, W.; Krotscheck, E. Phys. Lett., 44A: No. 5, 339-340(2 Jul 1973).

The giant Vela glitches are attributed to crustquakes which are induced by a shrinking of the interior, which in turn follows from the formation of a neutronic quantum crystal. The timescale for the epoch of quakes is set by the cooling of the neutron star, and for the interval between individual quakes by the crust's deformation. A total neutrino luminosity of $L_\nu \sim 10^{39}$ to 10^{40} erg/s is estimated together with thermal radiation peaking at an energy of some keV. (auth)

30846 X-RAY EMISSION REGION OF A WHITE DWARF WITH ACCRETION. Aizu, K. (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1184-1194(Apr 1973).

As a model of x-ray stars of the Sco X-1 type the accretion of gas by a white dwarf is studied, and, in particular, the structure of a hot plasma formed by the accretion is examined in detail. It is found that the temperature distribution in the plasma is determined only by the mass of the star, while the density and the thickness of this plasma depend also on the accretion rate. Thus the relative spectrum of thermal x-rays emitted from the hot plasma is determined only by the stellar mass, while the luminosity changes proportionally to the accretion rate. This feature is supported by recent observations of Sco X-1 by Matsuoka et al. The mass of the white dwarf of Sco X-1 is estimated as 0.29 $M_\odot$. (auth)

30847 STELLAR ACCRETION AND X-RAY SOURCE. 2. Sakashita, S. (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1763-1764(May 1973).

30848 NATURE OF CYGNUS X-3. Bruhweiler, F. (Univ. of Texas, Austin). Nature (London) Phys. Sci.; 244: No 135, 68-69 (30 Jul 1973).

The recently reported 4.8 hr sinusoidal periodicity in the x-ray flux of Cyg X-3 is stated to be unique in that all other periodicities associated with x-ray sources are either of the order of days, associated with orbital periods, or are quite short, indicative of pulsation or rotation of a compact source. The nature of this object is discussed and possible models are examined. (UK)

30849 MOLECULES AND GLOBULES IN ORION. Elliott, K. H.; Meaburn, J. (Univ. of Manchester, Eng.). Nature (London) Phys. Sci.; 244: No. 135, 69-70(30 Jul 1973).

It is stated that the variations in the ratio of the brightness of the [OII] lines B(3729)/B(3726) across H II regions can be used to

indicate variations in the local electron density throughout the nebular volume. This is the density experienced by the ions and electrons in the ionized material. For the Orion Nebula this local electron density decreases systematically from the center of the edge of the nebula. A large number of measurements of B(3729)/B(3726) has been made with the 98 inch Isaac Newton telescope across most of the core of Orion, and it was thought interesting to compare the contour map obtained with the corresponding radio map showing the brightness of the emission in a HCHO line. This suggested strongly that there is a close link between the ionized atomic material and the molecules in this H II region, and the molecules seem more concentrated where the ionized material of globules is most dense. It has been suggested that the ionized material in the center of Orion is composed predominantly of a mass of small ionized globules with dense neutral cores, and it would seem that molecules could occur in the cool neutral centers of these globules. (UK).

30850 5GHz OBSERVATIONS OF SMALL-SCALE STRUCTURE IN DR21. Harris, S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 5P-10P(1973).

The H II region DR21 has been observed with the Cambridge 5-km telescope at 5.00 GHz. It is resolved into four compact components of high density and small linear dimensions, surrounded by diffuse envelopes of lower density. The condensations may be at a higher electron temperature than the envelopes. (auth)

30851 THIRTEEN NEW PULSARS. Davies, J. G.; Lyne, A. G.; Seiradakis, J. H. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Nature (London) Phys. Sci.; 244: No. 136, 84-85 (6 Aug 1973).

The low-latitude pulsar survey, using the Mark 1A radio telescope at Jodrell Bank in 1972, was continued in May and June 1973, using the same technique (Nature 240:229 (1972)). Thirteen new pulsars were discovered, the principal characteristics of which are given in tabular form, together with the best available data on pulse shapes in graphical form. The data were obtained with a normal pulsar observation system, that allows more precise measurements to be made of period, position, pulse shape, and flux density. A search was also made of areas immediately surrounding 16 supernova remnants— no pulsar of mean flux $> 0.06 \times 10^{-26} W/m^2/Hz$ was detected. (UK)

30852 ARRIVAL TIMES OF 100 TO 400 keV PULSES FROM NP0532. Kurfess, J. D.; Share, G. H. (Naval Research Labs., Washington, DC). Nature (London) Phys. Sci.; 244: No. 133, 39(16 Jul 1973).

It is stated that for the pulsar in the Crab Nebula (NP 0532) at energies of a few hundred keV the relatively high flux of photons permits the detailed pulse structure to be observed, and it is important to compare the time of arrival of the primary x-ray pulse at these energies with the optical data. On two occasions in October 1970 the pulsar was observed from beneath ~4.5 g/cm^2 of atmosphere with a detector sensitive to hard x radiation and low-energy γ rays (Astrophys J. Lett. 168; L.39 (1971)), and a combined "light curve" was plotted from the two flights for 100- to 400- keV x rays. The absolute phase of the x-ray pulses relative to the optical pulses, however, was not determined. The present authors re-analyzed the 100- to 400-keV data to determine the absolute phase of the high energy x-ray pulsations. Histograms are shown for the distribution of X-ray events against phase. It was concluded that the primary peak observed at energies between 100 and 400 keV arrives at the Earth within about 0.5 ms of the primary optical peak. The 0.5 ms uncertainty places an upper limit of ~150 km for the distance between the regions producing the optical and x-ray emissions. (UK)

30853 OPTICAL VARIABILITY IN BL LACERTAE. Weistrop, D.; Goldsmith, S. (Tel-Aviv Univ., Ramat Aviv, Israel). Astrophys. Lett.; 14: No. 4, 225-229(1973).

Photographic observations of BL Lac for the period August 1972 to January 1973 are presented. Generally, the data show the kind of behavior previously observed in this object. Assuming the radio and optical variations are related, a lower limit of 5 kpc was determined for the distance to BL Lac. A two-part model to explain the relationship between optical and radio emission is proposed. (auth)

30854 PROBLEM OF IDENTIFYING RADIO SOURCES. Veron, P.; Veron, M. P. (Tel-Aviv Univ., Ramat Aviv, Israel). Astrophys. Lett.; 14: No. 4, 237-239(1973).

Although it is a priori possible that the position of a radio source does not coincide with the position of its optical identification, it is shown that in three such cases one may be explained by an erroneous identification (4C 24.18) and in the two others (3C 94 and 4C-05.93) the quasars found near the radio positions may not be associated with the radio sources. (auth)

30855 ELECTROMAGNETIC RADIATION FROM A ROTATING MAGNETIC DIPOLE. Kaplan, S. A.; Eidman, V. Ya. (Scientific Research Inst. of Radiophysics, Gorki, USSR). Astrophysics (Engl. Transl.); 7: No. 2, 183-185(1971).

Translated from Astrofizika; 7: No. 2, 310-313(1971).

In pulsars the problem of calculating the power of the electromagnetic radiation emitted by a rotating magnetic dipole is encountered. The problem considered is that of a wavy magnetic field force tube intersecting the surface of a pulsar. (WDM)

30856 QUASAR VARIABILITY AS A FUNCTION OF ABSOLUTE LUMINOSITY. Ames, S.; Bahcall, J. N. (Inst. for Advanced Study, Princeton, NJ). Astrophys. Lett.; 14: No. 4, 199-202(1973).

The relation between absolute optical luminosity and optical variability is examined for quasars. Broad categories of quasar theories lead to different expectations for this relation. The available data do not support any of the simple theories. Additional observations are suggested that would permit more restrictive theoretical inferences. (auth)

30857 CLUSTERING EFFECTS AMONG CLUSTERS OF GALAXIES AND QUASI-STELLAR SOURCES. Bogart, R.S.; Wagoner, R.V. (Department of Astronomy, and Center for Radiophysics and Space Research, Cornell University). Astrophys. J. 181: No. 3, 609-618 (1 May 1973).

A nearest-neighbor statistical test for angular correlations among sets of extragalactic objects is described which avoids many of the problems associated with other methods. Using this test, it is found that within their respective distance groups, distant rich clusters of galaxies from Abell's catalog are significantly clustered. On the other hand, there is (somewhat contradictory) evidence for an anticorrelation between the less distant and more distant clusters. There is slight but not compelling evidence for an apparent correlation between quasi-stellar radio sources of redshift $Z \geq 0.3$ and Abell clusters ($Z \leq 0.2$). (auth)

30858 PULSAR NP 0532: VARIABILITY OF DISPERSION AND SCATTERING. Rankin, J.M. (Department of Physics and Astronomy, University of Iowa, Iowa City); Counselman III, C.C. Astrophys. J. 181: No. 3, 875-889 (1 May 1973).

Observations of the Crab Nebula pulsar NP 0532 over a period of 22 months are analyzed for effects of interstellar scattering and dispersion. The two phenomena are distinguished on the basis of a simple model which considers the possible contributions of two scattering regions following Counselman and Rankin. Variations are observed in dispersion and in one of the scattering regions which are imperfectly correlated. The two regions exhibiting appreciable scattering can plausibly be identified as the general intervening galactic medium and the Crab Nebula itself, respectively. The variability, which occurs on a scale of months, is thus presumed to occur within the nebula. Scargle and Pacini's suggestion of an association between dispersion "events," "wisps" in the Crab Nebula, and timing irregularities ("glitches") of the pulsar is evaluated in the light of the observations. (auth)

30859 THE NUMBER-INTENSITY DISTRIBUTION OF X-RAY SOURCES OBSERVED BY UHURU. Matilsky, T.; Gursky, H.; Kellogg, E.; Tananbaum, H.; Murray, S.; Giacconi, R. (American Science and Engineering, Cambridge, Massachusetts). Astrophys. J. 181: No. 3, 753-759 (1 May 1973).

The Uhuru catalog of X-ray sources is used to analyze the number versus apparent-intensity relation of X-ray objects, by constructing (log N, log S) -plots similar to those used in radio astronomy. The source number distribution is corrected for nonuniform sky coverage of the spacecraft. Two distinct distributions for objects at low ($|b| < 20°$) and high ($|b| > 20°$) galactic latitude are discussed. The distribution for low galactic latitude objects (which are mainly galactic) gives further information on their location within the Galaxy and their intrinsic luminosity. The distribution for high-latitude objects is consistent with an extragalactic origin of these sources. Evidence from the longitudinal distribution of these objects is used to further demonstrate their extragalactic nature. (auth)

30860 ON THE DISTANCES TO TRANSIENT X-RAY SOURCES. Silk, J. (Berkeley Astronomy Department, University of California). Astrophys. J. 181: No. 3, 747-751 (1 May 1973).

From a discussion of the x-ray data, it is argued that the transient X-ray sources must be galactic, and must possess peak luminosities comparable with the strongest known galactic X-ray sources. The distribution of transient sources is predicted to be that of a halo population, and their frequency of occurrence is estimated as a function of flux level. (auth)

30861 THE HELIUM ABUNDANCE OF 3C 273. Jura, M. (3438 University Place, Baltimore, Maryland). Astrophys. J. 181: No. 3, 627-632 (1 May 1973).

Models with a time-dependent ionizing flux are sketched for 3C 273. In contrast to models with a steady ionizing flux in which a very low

helium abundance is inferred, in time-dependent models the observation of weak He II 4686 is consistent with a solar helium abundance. This result arises from the more rapid recombination of He^{+2} compared to H^+ following a burst of ionizing radiation. (auth)

30862 THE ABSORPTION LINES IN QUASI-STELLAR OBJECTS. Cohen, J.G. (Department of Astronomy, University of California at Berkeley). Astrophys. J. 181: No. 3, 619-625 (1 May 1973).

The gas producing the absorption lines seen in the spectra of some high-redshift QSOs can be physically related to the QSO or it can be located by chance on the line of sight to the quasar. If it is physically adjacent to the quasar, it will be photoionized and the observed pattern of absorption lines can be produced. However, an ejection model has great difficulty explaining the sharpness of the observed adsorption features compared with the large difference between absorption and emission redshift. A model in which the gas is part of the intergalactic medium or the extreme outer parts of galaxies is discussed. In this case, the gas may be collisionally ionized. To produce the observed ions C iv, N v, and O vi in absorption, the temperature must be about 10^5 °K. For solar metal abundance, it is then surprising that Lα is the strongest line in absorption. An attempt to enhance the Lα absorption by adding a cool region in which hydrogen is predominantly neutral fails as this region is photoionized by radiation from the hot region. Therefore, the metal abundance in the absorbing gas must be less than solar if the gas is not photoionized. (auth)

30863 PULSAR DETECTIONS AT FREQUENCIES OF 8.4 AND 15.1 GHZ. Downs, G.S.; Reichley, P.E.; Morris, G.A. (Jet Propulsion Laboratory, California Institute of Technology). Astrophys. J. Lett. 181: No. 3, L143-L146 (1 May 1973).

Eleven pulsars were observed and five were detected at 15.1 GHz. Several exhibit strong scintillations at 8.4 GHz. Estimates are made of the spectral indices of five pulsars. Average pulse shapes are presented for the stronger signals. (auth)

30864 SLOW VARIATIONS OF PULSAR INTENSITIES. Huguenin, G.R.; Taylor, J.H. (Five College Radio Astronomy Observatory, University of Massachusetts, Amherst); Helfand, D.J. Astrophys. J. Lett. 181: No. 3, L139-L142 (1 May 1973).

We present observations of the day-to-day intensity fluctuations of five pulsars, extending throughout most of 1971 and 1972. Each source shows a total variation of about a factor of ten over this period, with characteristic fluctuation times of 20 to 70 days. (auth)

30865 THE SPECTRUM AND VARIABILITY OF HERCULES X-1 OBSERVED BY OSO-7. Ulmer, M.P.; Baity, W.A.; Wheaton, W.A.; Peterson, L.E. (University of California, San Diego). Astrophys. J. Lett. 181: No. 1, L33-L37 (1 Apr 1973).

We report observations of Her X-1 (HZ Her) with the UCSD OSO-7 X-ray telescope 1971 December 8-11 and 1972 May 29-June 1. The time variable phenomena we see are: (1) the 1.7-day eclipse; (2) the X-ray source is seen more than one day before predicted (1972 May 31) by the 35.7-day ON-OFF cycle; (3) evidence for precursor "dips" in intensity relative to the eclipse (1.7-day period). We also show that the number spectrum (photons cm^{-2} s^{-1} keV^{-1}) steepens by ≈2.5 in the spectral index (from ≈1) above ≈25 keV. (auth)

30866 LIGHT CURVE OF HZ HERCULIS. Petro, L.; Hiltner, W.A. (University of Michigan). Astrophys. J. Lett. 181: No. 1, L39-L42 (1 Apr 1973).

The optical counterpart of Her X-1 was observed for B-magnitude on 34 nights between 1972 July 30 and 1972 October 10. The scatter in the light curve is about 0.5 mag and may be related to the 35-day cycle. (auth)

30867 EVIDENCE FOR THE BINARY NATURE OF 2U 1700-37. Jones, C.; Forman, W. (Harvard College Observatory, Cambridge, Massachusetts); Tananbaum, H.; Schreier, E.; Gursky, H.; Kellogg, E.; Giacconi, R. Astrophys. J. Lett. 181: No. 1, L43-L48 (1 Apr 1973).

Analysis of Uhuru data on the X-ray source 2U 1700-37 has revealed the presence of regular occultations. The period is 3.4 days with an occultation duration of 1.1 days. The source is highly variable on a time scale of minutes. Significant intensity variations have also been observed on a time scale of 0.1 second with a 3 σ upper limit of 17 percent on the percentage periodically pulsed. The energy spectrum is flat and shows a large amount of low-energy absorption. The data indicate that 2U 1700-37 is an X-ray source in a binary system. The 6.6-mag O7f star HD 153919 is suggested as the optical candidate. (auth)

30868 NOTCHES IN THE AVERAGE PULSE PROFILE OF THE PULSAR PSR 1919+21. Hankins, T.H. (Department of Applied Physics and Information Science, University of California at San Diego). Astrophys. J. Lett. 181: No. 1, L49-L52 (1 Apr 1973).

Deep notches in the average pulse profile of PSR 1919+21 have been revealed by a predetection dispersion-removal technique, suggesting that the pulsar emission mechanism is distinct from the mechanism that forms the average pulse profile. (auth)

Solar Phenomena

Refer also to abstract 30779.

30869 (AD-731083) CATALOG OF DISTINCT SOLAR RADIO EVENTS FOR FIXED FREQUENCY OBSERVATIONS MADE AT THE PENNSYLVANIA STATE UNIVERSITY RADIO ASTRONOMY OBSERVATORY DURING THE PERIOD 1 JULY 1964-30 JUNE 1970. Section 1. Data Reduction Procedures. Hagen, J. P.; Wefer, F. L. Aug 1971. Contract NSF-GP-2986. 82p. NTIS.

A description of the equipment and a discussion of the radiometer system parameters are given. The measurement of solar radio flux densities is discussed in detail. The procedures used to correct the data for various effects, including an approximate correction for the atmospheric attenuation, are given. The factors affecting the accuracy of the flux density data are discussed and it is shown that the mean errors in the relative burst flux densities are about 8, 7, and 8% for 10.7 GHz, 2.70 GHz, and 960 MHz, respectively. (auth)

30870 (AD-755920) DEVELOPMENT AND IMPLEMENT TECHNIQUES TO PREDICT SOLAR ACTIVITY AND ITS GEOPHYSICAL EFFECTS. Final Report, November 1969-October 1972. Enger, I.; Fisher, G. E.; Chisholm, D. Nov 1972. Contract F19628-70-C-0111. 40p. (GEOMET-MF-161; AFCRL-72-741).

The solar-geophysical data base previously assembled for the period January 1, 1955 through February 28, 1968, was extended to October 31, 1969. X-ray burst data were added to the base; 2 to 12A for the period July 3, 1966 through August 12, 1969 and 1 to 8A from March 13, 1968 through August 12, 1969. An objective technique was developed for predicting the duration of the largest short-wave fadeout event (SWF) expected to be associated with a sunspot group tomorrow. An unsuccessful attempt was made to develop techniques for predicting 2 to 12A x-ray burst decay time once the burst has started. Equations were developed for predicting the geomagnetic index a (p) from 3 through 24 hours ahead. Future work is outlined. (auth)

30871 (AD-762205) SOLAR RADIO ACTIVITY IN AUGUST 1972. Castelli, J. P.; Barron, W. R.; Aarons, J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 24 Jan 1973. 37p. (AFCRL-TR-73-86; AFCRL-PSRP-532). NTIS.

A wide variety of both conventional infrequently observed phenomena took place during the disk passage of McMath Plage No. 11976. A summary of the more important solar radio activity is presented. The largest of the bursts on 2, 4, and 7 August had proton association which is correlated quantitatively with burst integrated flux density. One of the events was visible in white light and also had an associated ground level event. The spectra of the largest bursts are considered. As early as July 31, 1972, many unusual bursts at wavelengths shorter than 3 cm were observed as point brightenings with excellent x-ray association. Though discussions are at times presented, the emphasis of this report is on presentation of data. (GRA)

30872 (CONF-730301-P2, pp 1031-1032) SOLAR NEUTRINOS AND M1 TRANSITIONS IN ^{8}Li EXCITED BY 180° ELECTRON SCATTERING. Fagg, L. W.; Bendel, W. L.; Ensslin, N.; Jones, E. C. Jr. (Naval Research Lab., Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Recently it has been suggested that the existence of a narrow 0^+ state at about 11.5 MeV in ^{8}Be, that is at the ^{3}He + ^{3}He separation energy, could explain why the measured high-energy solar neutrino flux is almost an order of magnitude lower than theoretically predicted. The analog of a ^{8}Be state near the ^{3}He + ^{3}He threshold is expected to lie at about 15.2 MeV in ^{8}Li. Accordingly, using 37, 50, and 60 MeV electrons scattered at 180° from a ^{8}Li (34.7 mg/cm^2, 99.32% enrichment) target, M1 transitions to states in the excitation energy region from 8.3 to 18.4 MeV were sought. The experiment was conducted with the NRL 180° electron scattering apparatus including a new overlapping detector system consisting of 25 channels with associated computerized data accumulation. (WDM)

30873 (N-73-11811) APPLICATION OF AVCO DATA ANALYSIS AND PREDICTION TECHNIQUES (ADAPT) TO PREDICTION OF SUNSPOT ACTIVITY. Final Report. Hunter, H. E.; Amato, R. A. (AVCO Government Products Group, Lowell, Mass.

(USA)). Aug 1972. Contract NAS8-28087. 212p. (NASA-CR-123925; AVSD-287-72-CR). NTIS.

The results are presented on the application of Avco Data Analysis and Prediction Techniques (ADAPT) to derivation of new algorithms for the prediction of future sunspot activity. The ADAPT derived algorithms show a factor of 2 to 3 reduction in the expected 2-sigma errors in the estimates of the 81-day running average of the Zurich sunspot numbers. The report presents: (1) the best estimates for sunspot cycles 20 and 21, (2) a comparison of the ADAPT performance with conventional techniques, and (3) specific approaches to further reduction in the errors of estimated sunspot activity and to recovery of earlier sunspot historical data. The ADAPT programs are used both to derive regression algorithm for prediction of the entire 11-year sunspot cycle from the preceding two cycles and to derive extrapolation algorithms for extrapolating a given sunspot cycle based on any available portion of the cycle. (auth)

30874 (N-73-14806) PROGRAM OF SOLAR WIND DATA ANALYSIS UTILIZING DATA FROM PIONEER 6, MARINER 5, AND EXPLORER 35. Final Report. Siscoe, G. L. (California Univ., Los Angeles (USA). Dept. of Meteorology). 13 Sep 1972. 11p. (NASA-CR-129880). NTIS.

A combined data analysis and theoretical program aimed at interpreting and utilizing solar-wind data obtained from Pioneer 6, Mariner 5, and Explorer 35 has been completed. A theoretical model of the radial dependence of large scale solar-wind inhomogeneities was developed and used to map solar-wind variations measured by Explorer 35 to various heliocentric distances and to the orbits of Mercury, Venus, and Mars. The model was also used to determine power spectra velocity, density and temperature variations of 20 $R_{\odot}$ from spectra obtained from the Mariner 5 data at an average heliocentric distance of 180 $R_{\odot}$. Five stream-stream interaction events in the Pioneer 6 data were analyzed which confirmed the picture of a spiral compression ridge interfacing the two streams and the associated east–west deflections of the solar-wind flow. Magnetopause crossings observed in Explorer 35 plasma data were used to develop statics on boundary motions at lunar distance. A study of the geomagnetic disturbance field asymmetry was performed and a model of disturbance field from a partial ring current was developed. (auth)

30875 (N-73-16795) MDAC SOLAR COSMIC RAY EXPERIMENT ON OGO-6. Final report, March 1966–January 1973. Masley, A. J. (McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. (USA). Space Sciences Dept.). Jan 1973. Contract NAS5-9324. 47p. (NASA-CR-130155; MDC-G-4351). NTIS.

The instrumentation of the OGO-F solar cosmic-ray experiment is described and results of data obtained during the satellite lifetime from launch on June 5, 1969, through September, 1970, are discussed. (auth)

30876 ^{247}Cm AS A SHORT-LIVED R-PROCESS CHRONOMETER. Blake, J. B.; Schramm, D. N. (Aerospace Corp., Los Angeles). Nature (London) Phys. Sci.; 243: No. 130, 138-140 (25 Jun 1973).

The chronological possibilities of the r-process nuclide ^{247}Cm, of half life 1.6×10^{7} yr., are discussed. This nuclide decays to ^{235}U, and if a large ^{247}Cm/^{238}U fractionation in minerals occurred it could be detected as an enhancement in the abundance of ^{235}U relative to ^{238}U. There is no doubt that ^{129}I was present in early solar system material, and since ^{129}I and ^{247}Cm have almost identical half-lives and both nuclei are produced in the r-process ^{247}Cm must also have been present. Observations of Cm–U fractionation would provide evidence for assumptions concerning. Pu–U fractionation made in chronological studies, and data on the relative abundances of Th, U, Pu, and Cm in meteoritic samples would permit better assessment of the magnitude of the fractionation that occurred. Data on the production of Cm would also give an insight into the r-process and the presence of post-event neutron fluxes. The Cm chronometer might be used, similarly to the Rb–Sr and I–Xe chronometers, to measure small differences in formation time in the early solar system, and might help in the resolution of conflicting I–Xe and Rb–Sr results in recent meteoritic measurements. (UK)

30877 HYDROMAGNETIC STABILITY OF A COMPOSITE PLASMA IN THE PRESENCE OF HALL CURRENTS. Bhatia, P. K.; Gupta, P. N. (Univ. of Jodhpur, India). Nuovo Cim., 17B: No. 1, 203-211(11 Sep 1973).

The dynamic stability of a composite hydromagnetic plasma was studied to include simultaneously the effects of neutral-gas friction, Hall currents, and viscosity. The prevailing magnetic field was assumed to be uniform and vertical. It is first shown that the solution is characterized by a variational principle. An explicit solution was obtained for a semi-infinite composite plasma in which the density had a one-dimensional gradient along the vertical. It was found that the system is unstable for all wave numbers. (auth)

30878 OBSERVATIONS OF THE ZODIACAL LIGHT AT 2.4 μm. Hofmann, W.; Lemke, D.; Thum, C.; Fahrbach, U. (Max Planck-Institut fuer Astronomie, Heidelberg). Nature (London) Phys. Sci.; 243: No. 130, 140-141(25 Jun 1973).

Measurements are described of the near infrared brightness of the zodiacal light, made with a balloon-borne telescope launched in October 1972 from the NCAR balloon flight station, Palestine, Texas. Because of the intense OH airglow such measurements are in general not possible from the ground, and not even from balloon altitudes, except for a gap in the airglow spectrum at λ = 2.4 μm. The results did not confirm the only previously reported measurements in the near infrared obtained by Hayakawa in rocket experiments. The small excess intensity found at 2.4 μm could result from scattering processes, or from thermal emission of the interplanetary dust grains, or from both, but is interpreted as due only to thermal emission in order to derive a maximum temperature for the grains. (UK)

30879 PRAESEPE AND THE SOLAR NEUTRINO PROBLEM. Smith, R. C. (Univ. of Sussex, Eng.). Nature (London); 244: No. 5418, 560(31 Aug 1973).

It has been suggested (Sagan and Young, Nature 243: 459(1973)) that the solar neutrino problem (and also the apparent presence of river channels on Mars) may be resolved by variations of 10 to 20% in the solar luminosity, and the observed width of the main sequence in Praesepe has been quoted as evidence that such luminosity changes have occurred in other solar type stars; but the main sequence width has previously been interpreted as due to the observed spread in rotational velocity of the stars. The question of whether these interpretations are mutually exclusive or could be compatible is discussed. It is concluded that although the evidence from Praesepe does not necessarily contradict the hypothesis of Sagan and Young, neither does it positively support it, and it is possible to explain the observed width of the main sequence in a much less "exotic" way. (UK)

30880 ARE THE JOVIAN PLANETS FAILED STARS. McNally, D. (London Univ.). Nature (London); 244: No. 5416, 424-426 (17 Aug 1973).

The author suggests that division of planetary bodies into solid and gaseous types may imply different formation mechanisms, and that the terrestrial planets formed in a high-density shell surrounding the proto-Sun whilst the Jovian planets which are cold gaseous bodies, are the remnants of attempts to form stars contemporary with the Sun. The matter is discussed in relation to gravitational collapse and rotation. If, however, "failure" to form a star can occur, why is it possible for a star to form in some situations and not in others, particularly as it is clear that if the Jovian planets are "failed" stars, collapse has proceeded almost to the stellar state. What could prevent ultimate evolution to the stellar state? Clearly it is not proximity to the Sun, since some binary stars have separations of <0.05 AU. Numerical studies on the collapse of rotating gas clouds in two and three dimensions are described and possible mechanisms are discussed. (UK)

30881 EQUATORIAL CURRENTS IN THE PHOTOSPHERE. Plaskett, H. H. Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 183-207(1973).

From spectra photographed at Oxford in 1966 and 1968 sight-line velocities of the equatorial zone of the Sun are tabulated. After correction of these for limb effect an axisymmetric solution gives the zonal and meridional components of photospheric velocity. In the Northern and Southern Hemispheres of an equatorial zone of constant angular velocity there occurs at a latitude of some 10° a dominantly meridional current. The properties of the current are described, a possible origin of its meridional part proposed and some suggestions are made on why the current has hitherto escaped detection. (auth)

30882 OBSERVATIONS OF THE LINEARLY POLARIZED INTENSITY OF THE NIGHT SKY RADIATION IN THE ANTI-SOLAR HEMISPHERE. Wolstencroft, R. D.; Bandermann, L. W. (Univ. of Hawaii, Honolulu). Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 229-237(1973).

Isophote maps of the linearly polarized intensity of the light of the night sky in the anti-solar hemisphere at 5080 Å have been obtained for nine nights from May 1969 to July 1971. They have a significant angular structure and show that night-to-night variations occur in the zodiacal light indicating changes in the degree and direction of alignment of the interplanetary dust particles. They give further evidence for polarization of the Milky Way and show the presence of regions of enhanced polarized intensity near the galactic equator. (auth)

30883 THE RECONNECTION RATE OF MAGNETIC FIELDS. Parker, E.N. (Department of Physics, Department of Astronomy and Astrophysics, University of Chicago). Astrophys. J. 180: No. 1, 247-252 (15 Feb 1973).

Solar flares, and the absence of intense small-scale magnetic fields in the turbulent solar photosphere, suggest that the reconnection rate, or merging speed, of two oppositely directed magnetic fields is of the general order of the Alfvén speed. The fluid between the opposite fields escapes via the well-known interchange and kink instabilities, permitting rapid close approach of the fields, and merging rates probably of the order of 0.1 V_A, or faster, in most cases. Hence reconnection is sufficiently rapid, with or without microinstabilities, that it plays a major role in solar flares and in the reduction of small-scale turbulent fields. (auth)

30884 DISSIPATION OF HYDROMAGNETIC WAVES WITH APPLICATION TO THE OUTER SOLAR CORONA. I. COLLISIONLESS PROTONS AND COLLISIONAL ELECTRONS. Hung, R.J.; Barnes, A. (Space Science Division, Ames Research Center, NASA, Moffett Field, California). Astrophys. J. 180: No. 1, 253-269 (15 Feb 1973).

We discuss the theory of hydromagnetic-wave dissipation for conditions likely to occur in most of the outer solar corona ($2\,R_\odot \lesssim r \lesssim 4R_\odot$). Magnetoacoustic waves of period $\sim$5 min are dissipated by ion Landau damping, just as in a perfectly collisionless plasma, even though ion-electron collisions are not neglected. For certain propagation directions, dissipation by (collisional) electron thermal conduction may occur. The implications of these effects for heating the outer corona are discussed. (auth)

30885 DISSIPATION OF HYDROMAGNETIC WAVES WITH APPLICATION TO THE OUTER SOLAR CORONA. II. TRANSITION FROM COLLISIONAL TO COLLISIONLESS ELECTRONS. Hung, R.J.; Barnes, A. (Space Science Division, Ames Research Center, NASA, Moffett Field, California). Astrophys. J. 180: No. 1, 271-284 (15 Feb 1973).

We discuss the theory of hydromagnetic wave dissipation in a region of transition between collisional and collisionless electron behavior. For waves of period 5 min, the period of maximum photospheric noise, this transition occurs in the solar corona at roughly 4 $R_\odot$ heliocentric distance. Electron viscous dissipation on the collisional side of the transition passes continuously into electron Landau damping as the electron collision frequency passes through the wave frequency. (auth)

30886 THE EXTREME-ULTRAVIOLET SPECTRUM OF Fe XV IN A SOLAR FLARE. Cowan, R.D. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico); Widing, K.G. Astrophys. J. 180: No. 1, 285-292 (15 Feb 1973).

Approximately 13 lines of Fe xv are identified between 200 and 500 Å in the slitless spectrum of a solar flare. Some of these are previously unclassified transitions from the experimentally unknown $3s3d\ ^1D_2$ and $3p^2\ ^1D_2$ levels. The intercombination lines $3s3P\ ^3P^0_{1,2}$–$3p^2\ ^1D_2$ check the position of the $^3P^0$ levels and confirm the classification of the intersystem line at 417.24 Å. Classification is made through comparison with HX calculated spectra of Fe xv and through comparison with isoelectronic laboratory spectra. The population of the metastable levels of $3s3p\ ^3P^0$ is calculated as a function of electron density, and $n_e = 4\times10^{10}$ in the flare is derived from the intensity ratio of the lines at 234 and 244 Å. Several new singlet lines of Fe xv are identified in nonflare solar slit spectra below 100 Å. The problem of the identification of the strong enhancing line at 69.66 Å is discussed. (auth)

30887 SOLAR OBLATENESS AND EQUATORIAL BRIGHTENING. Dicke, R.H. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. 180: No. 1, 293-305 (15 Feb 1973).

Equatorial brightening near the limb associated with an elevated temperature in the upper photosphere is discussed. It is not possible to obtain satisfactory agreement with observations simultaneously at both of the color bands employed for the observations. The energy requirements of such hypothetical excess photospheric temperatures are severe, and the stresses needed for a force balance do not seem to be present. (auth)

30888 SOLAR CORONAL GREEN LINE AS AN INDEX OF COSMIC RAY MODULATION. Peacock, D. S. (Univ. of Denver). Planet. Space Sci.; 21: No. 10, 1661-1670(Oct 1973).

In recent years several papers have indicated that the solar coronal green line emission (λ = 5303 Å) is the "best" indicator of cosmic-ray modulation. This paper questions this result for the following reasons: (a) the problems of green line measurement obscure the true meaning of the resulting observations; (b) there is a lack of any direct physical mechanism relating green line intensity and modulation; (c) a negative result came from a careful attempt to relate the cosmic-ray diurnal variation and green line emission. (auth)

30889 LINES OF Fe XVII AND Fe XVIII DURING A SOLAR FLARE. Brabban, D. H.; Glencross, W. M. (University Coll., London). Nature (London) Phys. Sci.; 244: No. 135, 67-68 (30 Jul 1973).

Details are given of observations made with a pair of crystal spectrometers flown on the sounding rocket Skylark SL 1003 launched from Woomera, South Australia, on 26 October 1972, at which time there were two main centres of activity on the solar disk. An uncollimated solar soft x-ray spectrum was obtained from 1.45 to 1.71 nm. Plane rubidium acid phthallate crystals were used to diffract the x-ray flux into thin windowed proportional counters. Strong lines of Fe XVII at 1.501 nm and at 1.677 nm clearly showed the presence of two main emitting regions. Two other groups of lines were observed that are not normally observed in quiet Sun spectra; most of these were identified as transitions in Fe XVIII, and the presence of many Fe XVIII lines was confirmed. As with all uncollimated spectra the wavelength assignments depend on the position of the source on the solar disk, and further analysis of the data using the spatial resolution of modulation collimators should provide confirmation of the present identifications and lead to estimates of relative line strengths and temperatures in the emitting regions. (UK).

30890 WEAKLY-SHOCKED FLOWS OF THE SOLAR WIND PLASMA THROUGH ATMOSPHERES OF COMETS AND PLANETS. Wallis, M. K. (Royal Inst. of Tech., Stockholm). Planet. Space Sci.; 21: No. 10, 1647-1660(Oct 1973).

The quasi-one-dimensional continuum description of the solar wind's ionizing interaction with neutral atmospheres is employed to describe the transsonic flow upstream of the body. The subsonic flow is approximated by assuming constant total energy density. Weakly-shocked solutions are found to mass-accreting flows, and they pass continuously over to shock-free solutions for low spatial gradients in the ionization rate. Flow computations currently in progress at Munich are in good agreement with these solutions. Cometary shocks are subcritically weak, and probably heat the electrons, but only moderately. These shocks occur inside the ionization region, close to the innermost position for strictly one-dimensional mass-accreting flows. These features conflict with the earlier flow calculations, which are in error as the authors (Biermann at al. (Solar Physics; 1: 254 (1967)) now recognize. The previous computational method is judged to be invalid. The shocks ahead of Venus and Mars can also be subcritical if the relevant density gradient is provided by a supra-thermal atmospheric component, or if charge exchange interactions effect rapid cooling of the plasma. (auth)

30891 ENHANCED SCINTILLATION SECTORS OUTSIDE THE PLANE OF THE ECLIPTIC. Houminer, Z. (Cambridge Univ., Eng.). Planet. Space Sci.; 21: No. 10, 1617-1624(Oct 1973).

The heliocentric latitude-dependence of enhanced scintillation sectors is studied by observing the day to day variation of scintillation index for sources with lines of sight in and outside the plane of the ecliptic. Comparison of the observations with theoretical computations shows that the scintillation sectors are confined to latitudes < 40°. (auth)

30892 BACKSCATTER OF SOLAR He2, 304 A RADIATION FROM INTERPLANETARY He^+. Paresce, F.; Bowyer, S. (Univ. of California, Berkeley). Planet. Space Sci.; 21: No. 10, 1795-1797(Oct 1973).

Backscatter of solar He II, 304 Å radiation by interplanetary He^+ is shown to be insufficient to account for recent observations. (auth)

30893 ALFVEN WAVES BEYOND THE SOLAR CORONA. Ferraro, V. C. A. (Queen Mary Coll., London). Rend. Semin. Mat. Fis. Milano; 42: 57-63(1972). (In Italian).

It is shown that beyond the solar corona, Alfvén waves excited in the solar wind in the presence of the interplanetary magnetic field travel with velocity $\pm\, v_A$ (v_A = Alfvén velocity) on the particle stream moving with the velocity of the solar wind. However, the amplitude of the waves and of the associated magnetic variations diminish with increasing distance and may be imperceptible at the distance of the Earth. (auth)

30894 THERMAL MODELS OF INHOMOGENEOUSLY ACCRETED METEORITE PARENT BODIES. Herndon, J. M.; Rowe, M. W. (Texas A and M Univ., College Station). Nature (London) Phys. Sci.; 244: No. 133, 40-41(16 Jul 1973).

It is stated that recent studies have suggested that Fe was fractionated early in planetary formation processes and that the terrestrial planets were inhomogeneously accreted. Thermal calculations are presented on a set of models of meteorite parent bodies in which initial formation of a Ni–Fe core is assumed, taking into account the differences in thermal properties and

distribution of radioactive heat sources that result from initial core formation followed by silicate accretion. For these calculations the finite difference numerical solution of the standard heat flow equation was used, with an additional boundary condition of heat flux continuity across the metal–silicate interface. The only heat sources considered are ^{238}U, ^{235}U, ^{232}Th, and ^{40}K, assumed to be uniformly distributed in the silicate regions and absent in the core, and it was assumed that meteorite parent bodies had completely formed 4.7×10^9 yr ago, with an initially uniform internal temperature distribution. The calculations indicate that core formation in meteorite parent bodies has only a small effect on cooling rates and times, but achieving high enough temperatures to melt the core without introducing short-lived radioactive heat sources remains a problem in all models. Two possibilities should be considered; first, if it is assumed that planetary accretion took place inhomogeneously, then the possibility that the short-lived radionuclide ^{60}Fe may have been of significance in heating the Fe core should be examined. For ^{60}Fe to have had any substantial heating effects core formation must have been rapid and of the order of 10^5 yr. The second possibility is to consider whether the structures observed in Fe meteorites could have arisen either from crystal growth from vapour or from the cool accretion of minute particles condensing directly from the solar nebula without ever having been reheated above the melting point. (UK)

30895 SIMULTANEOUS OBSERVATIONS OF FAST SOLAR ELECTRONS AND TYPE III RADIO BURST EMISSION NEAR 1 AU. Lin, R. P. (Univ. of California, Berkeley); Evans, L. G.; Fainberg, J. Astrophys. Lett.; 14: No. 4, 191-198(1973).

Simultaneous observations were made 1 AU of fast (0.5 to ~300 keV) solar electrons and type III radio burst emission at low frequencies (2.6 MHz to 44 kHz) for two events. At each frequency the position of the radio emission was located by the spin modulation of the received signal. Close agreement was observed between the onset of the radio emission origination near 1 AU and the arrival of the first electrons, and between the radio-burst drift rate at low frequencies and the electron propagation path length in the interplanetary medium. The observed fast electron energy spectrum was peaked at energies ranging from $\gtrsim$100 keV near radio burst onset to ~15 keV at burst maximum. This peaked distribution arises from the arrival of the fast electrons at 1 AU before the slower ones and not from a peaked distribution for the electrons initially released at the Sun. These observations are consistent with the plasma hypothesis for the generation of type III solar radio bursts with ~10 to $\gtrsim$100 keV electrons as the exciters of the emission. (auth)

30896 DOUBLE ION STREAMS IN THE SOLAR WIND. Feldman, W.C.; Asbridge, J.R.; Bame, S.J.; Montgomery, M.D. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico, 87544). J. Geophys. Res. 78: No. 13, 2017-2027 (1 May 1973).

Distinct interpenetrating ion streams have been identified in the solar wind for the first time. They are shown to be interplanetary in origin and to be associated with the filling in of regions of density rarefactions accompanying high-velocity streams. With few exceptions, the ion stream with the lower-energy density flux has higher energy. Furthermore, nonradial magnetic field directions seem to inhibit double ion streaming. It is tentatively suggested that the origin of solar wind double streaming is the breakup and merging of thin high-velocity filaments into regions of plasma rarefactions. (auth)

30897 SOLAR WIND TEMPERATURE AND SPEED. Burlaga, L.F.; Ogilvie, K.W. (Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland, 20771). J. Geophys. Res. 78: No. 13, 2028-2034 (1 May 1973).

When it is averaged on a time scale of several solar rotations, the solar wind proton temperature T increases monotonically with the bulk speed V (Hundhausen et al., 1970; Burlaga and Ogilvie, 1970). This macroscale T–V relation does not change appreciably with solar cycle. The temperatures corresponding to intervals of increasing speed are only $\simeq$15% higher than those corresponding to decreasing speeds, and thus it is indicated that the macroscale T–V relation is not appreciably affected by stream interactions. On a time scale of a tenth of a solar rotation there are time dependent T(t) –V(t) relations that are closely related to the stream profiles, as was noted by Hundhausen (1973). These T(t) –V(t) relations can meaningfully be resolved into two components—the macroscale T–V relation and systematic time dependent deviations from the macroscale relation. These results support the view that the macroscale T–V relation is not appreciably affected by nonsteady interplanetary processes but is determined rather by the proton heating mechanism within $\simeq$50 R_s. The systematic time dependent deviations between temperatures measured at streams and those given by the macroscale T–V relation are proably due primarily to nonlinear nonsteady processes in the interplanetary medium. (auth)

30898 EVOLUTION OF LARGE-SCALE SOLAR WIND STRUCTURES BEYOND 1 AU. Hundhausen, A.J. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado, 80302). J. Geophys. Res. 78: No. 13, 2035-2042 (1 May 1973).

The evolution of solar wind speed fluctuations beyond 1 AU is considered under the assumption that turbulent dissipation is negligible (except at shock fronts). Both a dimensional argument, giving the distance scale on which a shell of high-speed solar wind is 'smoothed' into the ambient, and numerical solutions of the nonlinear fluid equations indicate that the solar wind structures observed near 1 AU persist to well beyond 5–10 AU. In fact, the shock fronts associated with such structures under this set of assumptions are found to strengthen with increasing heliocentric distance. The comparison of these predictions with future solar wind observations should reveal the importance of large-scale turbulent processes in the interplanetary plasma. (auth)

30899 ANOMALOUSLY LOW PROTON TEMPERATURES IN THE SOLAR WIND FOLLOWING INTERPLANETARY SHOCK WAVES—EVIDENCE FOR MAGNETIC BOTTLES? Gosling, J.T.; Pizzo, V. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado, 80302); Bame, S.J. J. Geophys. Res. 78: No. 13, 2001-2009 (1 May 1973).

Occasionally, anomalously low values of the solar wind proton temperature T_p are observed when the solar wind velocity v is high. A large fraction of such measurements by the Vela 3 satellites follow the passage of interplanetary shocks by some 20–60 hours. Of 24 postshock events in which v exceeded 400 km sec^{-1} and for which Vela 3 measurements are available, 12 exhibited plasma states of anomalously low T_p, high v. The proton density at the time of these observations typically was depressed below normal, and the velocity tended to be constant or falling. A very strong association with abnormally high ($\geq$15%) concentrations of He^{++}/H^+ in the solar wind is noted for these anomalous proton temperatures, the usual temporal sequence of events at 1 AU being: (1) shock wave, (2) helium enrichment, and (3) low T_p, high v. It is suggested that these observations are consistent with a model for some shock wave disturbances that includes the ejection of new material (distinguished by the helium enrichment at 1 AU) into the solar wind at the time of large solar flares and the formation of a magnetic bottle configuration in the solar wind behind and within the ejecta. The anomalously low proton temperatures then result from the adiabatic cooling of the plasma within the magnetic bottle. (auth)

30900 PLASMA RADIATION FROM COLLISIONLESS MHD SHOCK WAVES AND THE HIGH-FREQUENCY WAVES IN THE UPSTREAM SOLAR WIND. Smith, D.F. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado, 80302). J. Geophys. Res. 78: No. 13, 2302-2307 (1 May 1973).

Interpretations of the high-frequency waves observed in the solar wind upstream from the earth's bow shock are considered, and it is concluded that explanation of significant magnetic components in terms of directly generated beam waves is untenable. Transformation of beam-generated electron plasma waves into radiation is analyzed. Sufficient transformation to explain the observations is possible if the electric field of the plasma waves is in the 25-mv/m range or higher so that the plasma waves amplify the radiation initially present. Such amplification leads to very directive radiation along the longest ray paths through the amplification or source region. This interpretation provides an explanation for the variable ratio of energy density in the electric field to that in the magnetic field. Namely, when these energy densities are low and comparable, we are observing almost pure highly directive electromagnetic radiation which either has decreased in amplitude in traveling from the amplification region or was produced in a small amplification region. When the energy density in the electric field is high and considerably larger than the magnetic energy density, the spacecraft is in an amplification region and sampling both radiation and plasma waves. (auth)

30901 AN ANALYSIS OF THE SOLAR EXTREME-ULTRAVIOLET SPECTRUM BETWEEN 50 AND 300 Å. Malinovsky, M. (Laboratoire de Physique Stellaire et Planetaire, 91 Verrieres-le-Buisson, France); Heroux, L. Astrophys. J. 181: No. 3, 1009-1030 (1 May 1973).

Photoelectric data on the solar spectrum between 50 and 300 Å obtained with a grazing-incidence rocket spectrometer flown on 1969 April 4 are given. The spectrometer viewed the entire solar disk. The spectrometer was calibrated photometrically over the complete wavelength range with an estimated accuracy of $\pm$25 percent. The intensities of the spectral lines were analyzed in detail to verify previous identifications of solar lines and to suggest new identifications. The method of Pottasch was also applied to determine the relative abundances of the elements O, Ne, Mg, Si, S, Fe, and Ni present in the Sun. (auth)

30902 STABILITY OF SOLAR WIND AGAINST ELECTROMAGNETIC STREAMING INSTABILITY. Buti, B. (Space Science Division, Ames Research Center, NASA, Moffett Field, California). Astrophys. J. 181: No. 3, 1055-1063 (1 May 1973).

The stability of the solar wind in the presence of small concentrations of helium against high-frequency ($\omega^2 > \Omega_p^2$) electromagnetic streaming instability is explored. For relative abundances of helium to hydrogen up to 20 percent for the expected magnetic fields, densities, and temperatures of the solar wind, this instability can be triggered only if the relative streaming of protons with respect to α-particles exceeds the electron thermal velocity. The solar wind cannot satisfy this requirement and hence is stable against this instability. (auth)

30903 SCIENTIFIC EXPLORATION WITH AN OUT-OF-ECLIPTIC SPACECRAFT. Wilcox, J. M. (Stanford Univ., CA). Comments Astrophys. Space Phys.; 5: No. 3, 75-85 (1973).

Specific aspects of space exploration with an out-of-ecliptic spacecraft are considered. Various solar regions are examined as a function of latitude in terms of sunspots, active regions, flares, and other solar activity. Particular attention is given to the latitude interval from about 35 to about 65°, a less known area where projection effects begin to hamper Earth-based observations, and to the polar regions above 65°, the least known areas. A possible orbit of an out-of-ecliptic spacecraft is plotted. (IAA)

30904 CHARGE STATES AND ENERGY-DEPENDENT COMPOSITION OF SOLAR-FLARE PARTICLES. Braddy, D.; Chan, J.; Price, P.B. (Department of Physics, University of California, Berkeley, California, 94720). Phys. Rev. Lett. 30: No. 14, 669-671 (2 Apr 1973).

During a weak solar flare, energy spectra of He, O, and Fe from 0.2 to ∼30 MeV per nucleon were measured with glass and plastic detectors exposed on the Apollo 16 spacecraft. The spectra were very steep and the abundance ratios Fe/O and O/He decreased rapidly with energy, approaching solar atmospheric ratios at energies above ∼5 MeV per nucleon. The shapes of the rigidity spectra suggest that the ions were completely stripped while being accelerated. (auth)

Galaxies

Refer also to abstracts 30825, 30838, 30857, 31087, and 31088.

30905 (AD-760013) APERTURE SYNTHESIS OF INTERSTELLAR NEUTRAL HYDROGEN IN ABSORPTION. II. Cygnus A, the Crab Nebula, and Other Sources. Greisen, E. W. (Owens Valley Radio Observatory, Pasadena, Calif.). 1973. Contract N00014-67-A-0094-0019. 47p. NTIS.

The Owens Valley Radio Observatory interferometer has been used to carry out a program of aperture synthesis in the interstellar neutral hydrogen line. The results of synthesis observations of Cygnus A, the Crab Nebula, and 3C 353 and single-spacing observations of W12 and 3C 147 are presented. Considerable spatial structure in the absorbing medium is found with scale lengths about 1 pC (and perhaps even as small as 0.14 pC) being common. Some of the small-scale features are seen as condensations within much larger clouds. The hydrogen densities appear to be mostly on the order of 100/cc. Upper limits to the temperatures lower than 50°K are found for some spectral components, but upper limits between 80 and 160°K are more common. The implications of these results for the two-phase model of the interstellar medium are discussed. (NTIS)

30906 POSSIBLE CORRELATION BETWEEN THE SOFT X-RAY FLUX AND FEATURES IN THE RADIO CONTINUUM IN THE ANTICENTRE. Berkhuijsen, E. M. (Max-Planck-Institut fuer Radioastronomie, Bonn). Nature (London) Phys. Sci.; 243: No. 130, 135-136(25 Jun 1973).

Observation of extended soft x-ray emission has been reported in the region $190° < l < 220°$, $-5° < b < +35°$ in the three energy bands $100 < E < 188$ eV, $120 < E < 284$ eV, and $450 < E < 950$ eV (Bunner and others Astrophys. J. 179: 781 (1973)), and it was shown that the high emission features found were not of solar or terrestrial origin, nor was a correlation found with known astronomical objects or features. The present author suggests a possible correlation with spurs in the galactic continuum radiation. (UK)

30907 HIGH RESOLUTION OBSERVATIONS OF NEUTRAL HYDROGEN IN M33. PT. 2. THE VELOCITY FIELD. Warner, P. J.; Wright, M. C. H.; Baldwin, J. E. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 163-182(1973).

The radial velocity field of H I in M33 is used to derive a rotation curve out to a radius of 6 kpc and to demonstrate that large scale deviations from circular motion within 4 kpc of the nucleus are less than 3 km s^{-1}. The overall agreement between the present H I and earlier H α radial velocities is satisfactory. A model of the distribution of mass indicates that all present data are consistent with a mass-to-light ratio of 5, almost independent of radius in the galaxy, a total mass M out to 6 kpc of 0.92×10^{10} $M_\odot$ and a ratio of M_{HI}/M of 0.10 within this radius. The thickness of the H I layer in the disk increases from 300 pc near the nucleus to 800 pc in the outer parts. A search for motions associated with a possible large scale density wave in the H I failed to detect any with an amplitude greater than 3 km s^{-1}. (auth)

30908 HIGH RESOLUTION MAP OF NGC1265. Wellington, K. J.; Miley, G. K.; Van der Laan, H. (Sterrewacht, Leiden). Nature (London); 244: No. 5417, 502-504(24 Aug 1973).

It is stated that the radio sources associated with NGC 1265 and IC 310 have "head-tail" structures with the heads coinciding with the optical galaxies, and it has been suggested that both radio sources were "ignited" by a relativistic particle wind from the nearby Seyfert galaxy NGC 1275. This hypothesis has been criticized, and it has been suggested that galaxies such as NGC 1265 are radio sources in their own right, not causally connected with any other galaxy. The elongated radio tails are then explained as trails left as active radio galaxies plough through the cluster medium. From observations made with the Westerbork synthesis radio telescope at 5 GHz in December 1972 and January 1973 a high resolution map of NGC 1265 was constructed that provided further evidence in favor of the "radio trail" hypothesis, and thereby for the existence of an intracluster medium. Interferometer baselines ranging in length from 36 to 1458 m. in steps of 18 m. were used. Some striking features of the map are described and discussed. It was difficult to envisage how such a radio source could be ignited from NGC 1275 or any other galaxy, and the features are interpreted only in terms of the "radio trail" hypothesis. (UK)

30909 LINEAR POLARIZATION OF THE REGION ROUND $l = 140^0$, $b = +8^0$ AT 240.5 MHz. Wilkinson, A. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 163: No. 2, 147-161(1973).

The results are presented of a brief survey of the linearly polarized background radiation, made at a comparatively low radio frequency. The survey partially covered the range $00^h < \alpha < 06^h$, $45° < \delta < 90°$, with a beamwidth of 1.5° arc. The sensitivity was about 1.5 K. The results are tabulated and presented as a vector plot. (auth)

30910 GALAXY FORMATION ASSOCIATED WITH ACTIVE GALAXIES AND THE BINDING OF RICH CLUSTERS. Silk, J.; Solinger, A. (Univ. of California, Berkeley). Nature (London) Phys. Sci.; 244: No. 137, 101-103(13 Aug 1973).

A mechanism is proposed for recent formation of dwarf galaxies in the vicinity of active radio galaxies. In the cores of rich clusters these dwarf galaxies are stripped of gas and eventually suffer tidal disruption. This leads to the suggestion that the Coma cluster of galaxies may be bound by intergalactic halo-type stars. (auth)

30911 SURVEY OF MOLECULAR LINES NEAR THE GALACTIC CENTER. III. 6-CENTIMETER FORMALDEHYDE ABSORPTION AT B=–2′ FROM L=2°.0 TO L=4°.5 AND AT B=–12′ FROM L=358°.5 TO L=2°.0. Scoville, N.Z. (Department of Astronomy, Columbia University); Solomon, P.M. Astrophys. J. 180: No. 1, 55-59 (15 Feb 1973).

Our initial survey in the 6-cm transition of formaldehyde near the galactic plane (b=–2′) has been extended out to l=4°.5, and a parallel strip at b=–12′ has been mapped between l=358°.5 and 2°.0. These new observations suggest that the group of dense, low-positive-velocity clouds does not continue beyond l=2° and that the negative-velocity clouds are part of an arm structure within 300 pc of the galactic center and having a total mass of $\sim 10^6$ $M_\odot$. We also note the existence of molecular gas at l=2°.3 with a velocity of 240 km s^{-1} (similar to that of H I in the rotating nuclear disk). (auth)

30912 GALACTIC GAS-TO-DUST RATIO FROM OBSERVATIONS IN THE DIRECTIONS OF SIXTEEN GLOBULAR CLUSTERS. Knapp, G. R.; Kerr, F. J.; Rose, W. K. (Univ. of Maryland, College Park). Astrophys. Lett.; 14: No. 4, 187-190(1973).

Galactic H I column densities were measured in the directions of 16 globular clusters with known color excesses. The observations give a mean value for the ratio of neutral hydrogen to visual absorption of $\sim 2 \times 10^{21}$ atom cm^{-2} mag^{-1}, and also show effects possibly attributable to the cloud-intercloud nature of the interstellar medium. From these measurements a value is found for the visual opacity in the interstellar medium of $k = 320$ gm^{-1} cm^2. (auth)

30913 MISSING OXYGEN IN THE ORION NEBULA. Dopita, M. A. (Univ. of Manchester, Eng.). Nature (London) Phys. Sci.; 244: No. 136, 85-86(6 Aug 1973).

It is stated that oxygen appears to be underabundant in the ionized gas of the Orion Nebula by a factor of four, and nitrogen by a factor of three, compared with solar abundances, and since oxygen is a very important cooling agent in H II regions this could remove the long-standing inconsistency between the theoretical temperatures of ~5000K and the much higher observed temperatures. Equilibrium temperatures of 7200 to 8700K are obtained with the observed abundances in much closer agreement with observation than the 4800 to 6700K given by solar abundance models. Because the Orion Nebula is within the local arm the abundances should not differ violently from solar values, and the important question is what has happened to the missing oxygen? The author suggests that it is contained in dust grains, silicates, and ice in interstellar space. (UK)

30914 SOUND GENERATED BY COSMIC TURBULENCE AND THE ORIGIN OF GALAXIES. Matsuda, T. (Kyoto Univ.); Takeda, H.; Sato, H. Progr. Theor. Phys. (Kyoto); 49: No. 5, 1770-1772 (May 1973).

30915 OPTICAL VARIABILITY OF THE COMPACT OBJECT X COMAE. Barbieri, C. (Astronomical Observatories of Padova and Asiago, Padua). Astrophys. Lett.; 14: No. 4, 231-232(1973).

The variability of the compact object X Comae has been confirmed from material taken with the Schmidt telescopes of the Observatory of Asiago. From 1959 to 1962 and from 1967 to 1973 the variable showed little or no fluctuation around the 18th blue magnitude, but an important brightening occurred in February–March 1972 of 1.3 mag in U, 0.9 mag in B, and 0.5 mag in V. The colors of X Comae at minimum are similar to those of N galaxies. (auth)

30916 ORIGIN OF THE ABSORPTION OF THE CENTER OF THE COMA CLUSTER. Smart, N. C. (Inst. of Astronomy, Cambridge, Eng.). Astrophys. Lett.; 14: No. 4, 233-235(1973).

The absorption observed through the central region of the Coma cluster of galaxies is discussed. It is shown that this absorption could be due to graphite grains and that these grains cannot be primordial in origin. The grains could be formed by carbon stars in the elliptical galaxies. These grains would travel freely through the galaxies into the intergalactic region. (auth)

30917 RESONANCE STARK EFFECT IN OH AND H_2O INTERSTELLAR MASERS. Slysh, V. I. (Cosmic Research Inst., Moscow). Astrophys. Lett.; 14: No. 4, 213-216(1973).

The a.c. Stark effect theory is applied to OH and H_2O radio sources. A splitting of molecular radio lines is found in the resonance radiation field, emitted by an ensemble of molecules. In a strong field broad satellites result, their spectral shape depending on statistics of the electric field amplitude. In a weaker field a Lorentz-shaped line is produced of a width equal to the induced transition rate. This allows the theory of saturated polarization-mode competition to be effective in OH sources under a wide range of conditions. Observational evidence suggests that the linewidth of spectral features in OH and H_2O maser sources could be affected by the resonance Stark broadening, and there are some indications of maser emission directivity. The third harmonic and Raman frequencies emission may be expected from the strongest OH and H_2O sources. (auth)

30918 UBV-PHOTOMETRY OF THE SPIRAL GALAXIES MARKARIAN 10 AND 79 WHICH POSSESS SEYFERT-TYPE NUCLEI. Dibai, E. A.; Lyutyi, V. M. Astrophysics (Engl. Transl.); 7: No. 2, 97-101(1971).

Translated from Astrofizika; 7: No. 2, 169-175(1971).

UBV observations are given for the two galaxies Markarian 10 and 79. The observations were made with the 125- and the 60-cm telescopes of the Crimean station of the Shternberg Astronomical Institute using a photoelectric photometer. Circular concentric diaphragms were used. On the basis of these observations, the radial distribution of surface brightness and color in these galaxies were calculated. A comparison of these Markarian galaxies with the Seyfert galaxies NGC 1275 and 7469 was carried out with the $(U-B)_0-(B-V)$ two color diagram. The conclusion is drawn that the color distribution along the galaxy's radius (in kiloparsecs) for Markarian 10 is similar to that for NGC 1275 and that of Markarian 79 is similar to that for NGC 7469. The color at the edge of Markarian 10 and NGC 1275 corresponds to stars of spectral class G, while the color at the edge of Markarian 79 and NGC 7469 corresponds to that of the redder stars of spectral class K. (auth)

30919 GALACTIC MODEL FOR GRAVITATIONAL RADIATION. Booth, D. J. (Huddersfield Polytechnic, Eng.). Int. J. Theor. Phys.; 7: No. 5, 327-337(1973).

Using the linearized theory of general relativity the gravitationally radiated energy emitted from a galactic model consisting of N gravitational radiators is calculated. The results are presented in terms of the lowest order contributing multipole moments (quadrupole), the orientations of radiators about a common reference frame, the distances between pairs of radiators, and the frequency of each radiator. From this model it is hoped that a reasonable lower bound to the gravitational energy flux from the galactic core can be computed. (auth)

30920 SPECTRA OF MARKARIAN GALAXIES. III. Arakelyan, M. A.; Dibai, E. A.; Esipov, V. F.; Markayan, B. E. (Byurakan Astrophysical Ovservatory, Erevan). Astrophysics (Engl. Transl.); 7: No. 2, 102-108(1971).

Translated from Astrofizika; 7: No. 2, 177-187(1971).

Results of spectral observations of 50 objects from the third list of galaxies with ultraviolet continuum are reported. Emission lines were detected in the spectra of 38 of them. The spectra of objects Nos. 231, 268, 270, 273, 279, and 290 had the wide emission lines characteristic of the nuclei of Seyfert galaxies. The Seyfert characteristics, although less pronounced, were manifested also in the spectra of objects Nos. 291 and 298. (auth)

30921 SURFACE BRIGHTNESS OF THE BARS OF SPIRAL GALAXIES. Kalloglyan, A. T. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 7: No. 2, 109-112 (1971).

Translated from Astrofizika; 7: No. 2, 189-195(1971).

Direct photometric measurements of 30 barred galaxies confirm the earlier conclusion that the surface brightness of most SB spiral galaxies, averaged over the bar axis, has a small dispersion and is independent of the galactic subtype. Some differences are found between the physical features of the nuclei of barred and normal spiral galaxies. The nuclei of barred galaxies have brightness which cluster near one particular value ($M_{pg} = -16.5$). The slight dispersion of the mean surface brightnesses of the bars is apparently due to the ejection of the bars from nuclei at a certain stage in their evolution. (auth)

30922 SPIRAL STRUCTURE OF BARRED GALAXIES. Chumak, O. V. (Astrophysical Inst., Alma-Ata, USSR). Astrophysics (Engl. Transl.); 7: No. 2, 113-115(1971).

Translated from Astrofizika; 7: No. 2, 197-201(1971).

A possible mechanism is discussed for the formation of the spiral structure of a barred galaxy. The bar is treated as a mechanical source which causes two travelling density waves of spiral shape in the adjacent medium. The mechanical energy of the bar is shown to be sufficient to maintain these density waves for $4 \cdot 10^{10}$ yr. (auth)

30923 STABILITY OF GRAVITATING SYSTEMS OF POINT MASSES. II. Cylinder With Monoenergetic Streams and Sphere With Circular Orbits. Bisnovatyi-Kogan, G. S. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 7: No. 2, 127-135(1971).

Translated from Astrofizika; 7: No. 2, 223-236(1971).

The discussion of the stability of an infinitely long, homogeneous, rigidly rotating cylinder of finite radius begun in Paper I is continued. Distribution functions are considered which contain monoenergetic streams along the z axis. It is shown by means of Nyquist diagrams that Jeans instability will always be present in this case. The stability of a sphere with circular orbits is demonstrated by the method of integration along trajectories; the results agree with those of Mikhailovskii et al. (auth)

30924 BARYONS AND ANTIBARYONS IN AN ANISOTROPIC UNIVERSE. Mishusten, I. N. (Moscow State Univ.). Astrophysics (Engl. Transl.); 7: No. 2, 158-163(1971).

Translated from Astrofizika; 7: No. 2, 271-279(1971).

The process involving the "chilling" of baryons and antibaryons at the stage of anisotropic expansion of the Universe is investigated, the consideration being carried out for both charge-symmetrical and charge-unsymmetrical worlds. The analytic dependence of the remanent concentration of baryons and antibaryons on the anisotropy parameter t_0 (the duration of the anisotropic stage of the expansion of the Universe) is constructed. It is shown that in order to obtain the observed baryon density in the symmetrical world it is required to have an unreasonably large value $t_0 > 10^{16}$ sec (without taking account of the effect of weakly interacting particles on the physics of the processes). Taking account of the effect of weakly interacting particles does not lead to substantial changes. (auth)

30925 NUMERICAL INTEGRATION SCHEME FOR THE N-BODY GRAVITATIONAL PROBLEM. Ahmad, A.; Cohen, L. (Hunter Coll., New York). J. Comput. Phys.; 12: No. 3, 389-402(Jul 1973).

A method for numerically integrating the N-body gravita-

tional problem is described. Advantage is taken of the fact that the force on a star can be divided into two parts which operate on different time scales. One part is due to the stars in the immediate vicinity of the star in question and another part due to the distant stars. The part of the force due to the far away stars changes much more slowly than the component due to the nearby stars. Hence that part of the force does not have to be recalculated as frequently as that due to the nearby stars. For systems with large N, most of the stars constitute the "distant" stars and the considerable saving of computing time allows us to integrate systems with up to 1000 particles. (auth)

30926 IONIZATION OF THE INTERCLOUD MEDIUM AND THE CENTRAL DISK REGIONS OF SPIRAL GALAXIES. Silk, J. (Berkeley Astronomy Department, University of California, Berkeley). Astrophys. J. 181: No. 3, 707-724 (1 May 1973).

The two-phase model of the interstellar medium is reconsidered in terms of a hydrogen ionization rate that may vary significantly between cloud and intercloud medium. In view of recent observational and theoretical studies directly pertaining to the ionization of H I clouds, it is proposed that the observed free-free absorption of extragalactic radio sources and nonthermal radio continuum can be produced predominantly in the intercloud medium. Various observational consequences of this hypothesis include interpretations of diffuse Hα and Hβ emission, radio recombination lines from distributed interstellar gas, and line emission from the central disk regions of nearby Sc galaxies. All these observational data can be explained in terms of a simple model of the intercloud medium, which is consistent with recent 21-cm studies of the interstellar medium. This necessitates a somewhat higher value of the hydrogen ionization rate than previously accepted, amounting to $\sim$ (1-3) $\times 10^{-14}$ s^{-1} in the intercloud medium, but permits a lower ionization rate ($\sim 10^{-17}$ s^{-1}) in H I clouds. An important difference with regard to earlier work is that the intercloud medium is required to possess a relatively clumpy distribution of ionization. Moreover, the intercloud rate of hydrogen ionization is required to increase by about an order of magnitude within the central regions of the Galaxy. Several ionization sources are discussed, and of these, blast-wave emission from supernova remnants and soft X-rays from ultraviolet dwarfs are found to be potentially viable candidates for the role of ionizing the intercloud medium. The role of these mechanisms is quantitatively evaluated, both in the solar vicinity and in the central disk regions of spiral galaxies. (auth)

30927 THE SPECTRUM OF THE EXTRANUCLEAR REGIONS OF TON 256. Silk, J.; Smith, H.E.; Spinrad, H. (Astronomy Department, University of California, Berkeley). Astrophys. J. Lett. 181: No. 1, L25-L26 (1 Apr 1973).

Scans of the nuclear and extranuclear regions of Ton 256 are consistent with a two-component model consisting of a central quasar-like nucleus embedded in a giant elliptical galaxy. The integrated visual magnitudes of the two components are comparable both to one another and to the magnitude of the brightest galaxy in a cluster at the same redshift. (auth)

Cosmology

30928 BLACK-HOLE COLLISIONS AS SOURCES OF GRAVITATIONAL RADIATION. Basano, L.; Morro, A. (Univ., Genoa). Nuovo Cim.; 17B: No. 1, 64-70(11 Sep 1973).

Black-hole collisions are discussed in terms of general conservation principles. The approach originally suggested by Hawking is extended to charged black holes; the event horizon area is found to increase, as it does in the case of neutral objects. The upper limit for the efficiency of gravitational radiation emitted in a reversible process turns out to be $1 - \sqrt{1 - e^2/(2m^2)}/2$. It is shown that the conservation of the irreducible mass is a more restrictive condition than the conservation of the surface area. (auth)

30929 GLOBAL DESCRIPTION OF SPHERICAL COLLAPSING AND EXPANDING DUST CLOUDS. Szekeres, P. (Univ. of Adelaide, Australia). Nuovo Cim.; 17B: No. 1, 187-195(11 Sep 1973).

Co-ordinate systems are derived which are everywhere smooth and globally cover the Oppenheimer-Snyder collapsing dust cloud. A co-ordinate system having these properties in the case of an oscillating dust cloud is also derived. The new co-ordinates enable the behavior of the clouds to be studied even after the attainment of the critical Schwarzschild radius. In particular the redshifts of photons emitted from and incident on the surface of the cloud are computed throughout its entire history. The results for clouds which are almost closed (topologically) indicate that they may be of significance in the production of gravitational waves and other energetic cosmogonic processes. (auth)

30930 CLOSED TIME AND ABSORBER THEORY. Pegg, D. T. (James Cook Univ. of North Queensland, Townsville, Australia). Nature (London) Phys. Sci.; 243: No. 130, 143-144(25 Jun 1973).

Reference is made to the closed time model Universe proposed by Davies (Nature 240:3 (1972)) to explain the 3K blackbody radiation. It is stated that if it is accepted that the second law of thermodynamics holds and therefore the arrow of time arises because fields are retarded, then the required time directions in the model can be obtained as a consistent solution of absorber theory. (UK)

30931 RADIO SOURCE DEPOLARIZATION, SIZE, AND COSMOLOGY. Strom, R. G. (Sterrewacht, Leiden). Nature (London) Phys. Sci.; 244: No. 131, 2-4(2 Jul 1973).

It is stated that data on radio source depolarization and the largest angular size against redshift correlation demonstrate the presence of geometrical effects predicted by relativistic cosmology and suggest the existence of significant amounts of intergalactic gas. (auth)

30932 ABSORBER THEORY OF RADIATION AND THE FUTURE OF THE UNIVERSE. Partridge, R. B. (Haverford Coll., PA). Nature (London); 244: No. 5414, 263-265(3 Aug 1973).

The power input to a microwave source remained constant to 1 part in 10^8 as it alternately radiated into free space and into a local absorber. In the framework of the Wheeler-Feynman absorber theory of radiation, this result sets some constraints on possible future properties of the Universe. (auth)

30933 THE ROLE OF NEUTRINOS IN THE EVOLUTION OF PRIMEVAL ADIABATIC PERTURBATIONS. Peebles, P.J.E. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. 180: No. 1, 1-5 (15 Feb 1973).

According to a recent suggestion, neutrinos may significantly hinder the growth of density irregularities in an expanding, radiation-dominated cosmological model. The effect is evaluated by direct numerical integration of the perturbation equations. Contrary to the suggestion, the effect is shown to be quite small. (auth)

30934 GRAVITY OF NEUTRINOS OF NONZERO MASS IN ASTROPHYSICS. Cowsik, R.; McClelland, J. (Department of Physics, University of California, Berkeley). Astrophys. J. 180: No. 1, 7-10 (15 Feb 1973).

If neutrinos have a rest mass of a few eV/c^2, then they would dominate the gravitational dynamics of the large clusters of galaxies and of the Universe. A simple model to understand the virial mass discrepancy in the Coma cluster on this basis is outlined. (auth)

30935 DEDUCTION OF THE INVERSE SQUARE LAW FROM NEWTONIAN COSMOLOGY. Landsberg, P. T. (Southampton Univ., Eng.). Nature (London) Phys. Sci.; 244: No. 135, 66-67 (30 Jul 1973).

Attention is drawn to a simple derivation of the cosmological differential equation from Newtonian cosmology. This is based (a) on the energy equation for a distribution of galaxies specified by vectors from a galaxy taken to be at the origin, and (b) the Hubble law. (UK)

30936 NEWTONIAN UNIVERSES EXPANDING OR CONTRACTING WITH SHEAR AND ROTATION. Davidson, W.; Evans, A. B. (Otago Univ., Dunedin, New Zealand). Int. J. Theor. Phys.; 7: No. 5, 353-378(1973).

Newtonian cosmology is examined fundamentally and an approach initiated by Narliker (Mon. Not. Roy. Astron. Soc.; 142: 129(1963)) is pursued in considerable detail. Homogeneous models expanding with spin and shear are shown unequivocally to possess a singularity. Nevertheless in the presence of sufficient spin they can pass through a well-behaved density maximum at some other epoch. Discrepancies between the conclusions of Narlikar and those of Heckmann & Shucking (Zeitschrift fur Astrophysik; 38: 95 (1955) and ibid; 40: 81 (1956)) are cleared up. Representative solutions, including models tentatively matched to the actual Universe are Illustrated. (auth)

30937 ABSORPTION OF HIGH-ENERGY COSMIC PHOTONS THROUGH DOUBLE-PAIR PRODUCTION IN PHOTON-PHOTON COLLISION. Brown, R. W. (Case Western Reserve Univ., Cleveland); Mikaelian, K. O.; Gould, R. J. Astrophys. Lett.; 14: No. 4, 203-205(1973).

At photon energies above 7.2×10^{20} eV, absorption by $\gamma + \gamma' \rightarrow 2e^+ + 2e^-$ dominates that from the lower-order process $\gamma + \gamma' \rightarrow e^+ + e^-$ for high-energy photons traversing a 2.8 K blackbody photon gas. Existence of the $2e^+$, $2e^-$ process and the cosmic blackbody radiation thus guarantees that the Universe is opaque for all photon energies above 10^{14} eV. The question of single-pair production in collisions with cosmic radio-wave photons is discussed, and the uncertainty in our knowledge of the important

low-frequency end of the radio spectrum is emphasized. Other processes ($\gamma + \gamma' \rightarrow$ muons, hadrons, etc.) are discussed briefly, and it is concluded that they are of minor importance. (auth)

30938 INTERACTION OF VORTEX AND IRROTATIONAL MOTIONS IN RELATIVISTIC HYDROMECHANICS. IV. Chernin, A. D.; Eidel'man, E. D. (Ioffe Inst. of Physics of Tech., Leningrad). Astrophysics (Engl. Transl.); 7: No. 2, 186-188(1971).

Translated from Astrofizika; 7: No. 2, 314-316(1971).

A formal solution of the equations of relativistic hydrodynamic is given. It is assumed that microscopic space velocities are small and gravitation of the medium can be neglected. The limiting case is considered in which the microscopic velocities approach the speed of light and an ultrarelativistic equation of state (the pressure amounts to $\frac{1}{3}$ of the density of energy) is realized. A solution is sought for the hydrodynamic equations in a class of self-preserving solutions containing a dependence on one space variable. (WDM)

Planetary Phenomena

Refer also to abstracts 29966, 30890, 31087, and 31088.

30939 ROTATION OF THE EARTH DURING THE 1972 SOLAR EVENT. O'Hora, N. P. J.; Penny, C. J. A. (Royal Greenwich Observatory Hailsham, Eng.). Nature (London); 244: No. 5416, 426-427(17 Aug 1973).

Reference is made to Gribbin and Plagemann (Nature 243: 26 (1973)) who, using UT observations of the U. S. Naval Observatory, claimed evidence of a discontinuous change in length of day and a change in the rate of change of length of day following a large solar storm on August 4th, 1972. This was claimed to confirm the prediction of these authors that such a storm could influence the rate of rotation of the Earth. The present authors reexamined the data and found no significant change in length of day in August 1972, and nothing more remarkable in Earth rotation than occurred several times in the year. (UK)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 29993 and 31707.

30940 (AD-737806) IONOSPHERIC ELECTRON CONTENT AND IRREGULARITIES OF ELECTRON CONCENTRATION AT LOW LATITUDES. Final Scientific Report, 1 October 1967–30 September 1970. Bhar, J. N.; Das Gupta, A.; Basu, S. (Institute of Science, Bombay (India). Inorganic and Nuclear Chemistry Lab.). Sep 1971. Contract F61052-68-C-0008. 95p. (AFCRL-72-25). NTIS.

The low-latitude ionosphere has a special character of its own owing to a strong control of geomagnetic field over the topside ionosphere. In order to explore the extent of this control, studies on total electron content and irregularities of electron concentration in the ionosphere were carried out at Haringhata Field Station (22°58′ N, 88°30′ E). The investigation on electron content was mainly oriented towards the determination of its latitude variation under varying geomagnetic conditions while those on the irregularities sought to obtain their axial ratio and spatial distribution. (auth)

30941 (AD-741784) DEVELOPMENT, INSTALLATION, AND DATA ANALYSIS FOR A SCANNING VLF RESEARCH RECEIVER EMPLOYED AT THE AIR FORCE GEOPOLE OBSERVATORY, THULE, GREENLAND. Final Report, 15 December 1970–15 December 1971. Oelbermann, E. J.; Smitley, C. R. (Pennsylvania State Univ., University Park (USA). Ordnance Research Lab.). 6 Mar 1972. Contract F19628-71-C-0103. 53p. (AFCRL-72-131). NTIS.

The report summarizes research and development connected with the use of a scanning vlf receiver at Thule, Greenland, to study polar cap disturbances during PCAs. The report describes the equipment, the quiet-day solar controlled patterns of a number of polar path vlf circuits, and vlf amplitude perturbations produced by solar proton events which occurred on September 1, October 3, and December 2, 1971. It is concluded that the vlf amplitude data are very sensitive and can be used to provide detection and tracking information on the movement of PCA centers across the polar cap. It is recommended that the scanned bandwidth be reduced and the sweep rate speeded up to shorten dead time and improve the time resolution of the system. (auth)

30942 (AD-745966) MATHEMATICAL AND STATISTICAL ANALYSIS FOR THE REDUCTION OF IONOSPHERIC DATA. Friedman, M.; Miller, D. C.; Reinhold, A. (Arcon Corp., Wakefield, Mass. (USA)). Jan 1972. Contract F19628-71-C-0034. 59p. (AFCRL-72-130). NTIS.

The report describes the techniques and programs developed to analyze various problems involving ionospheric physics. The main task consisted of the reduction and analysis of a large number of ionograms taken at various stations during the same time period. Programs were developed to perform statistical analysis on the data and to construct continuous models of the ionosphere based on these experimental observations. In connection with the development of these models, programs were designed and written to trace electromagnetic rays through different ionospheric models. (auth)

30943 (AD-746311) HF BACKSCATTER STUDY AT 19.4 MHz THROUGH SUBAURORAL IONOSPHERE. Basu, S.; Vesprini, R. L. (Emmanuel Coll., Boston, Mass. (USA)). May 1972. Contract F19628-71-C-0250. 48p. (AFCRL-72-332). NTIS.

The aim of this study was to determine the effects of direct scatter from field aligned E- and F-layer irregularities, as well as scatter from intense E(s) clouds on the 19.4 MHz oblique backscatter signal propagating via the F layer. (auth)

30944 (AD-747093) ENERGIZATION OF ELECTRONS IN MAGNETOPLASMA BY WAVE PARTICLE INTERACTION. Singh, R. N. (Banaras Hindu Univ., Varanasi (India). Inst. of Tech.). Mar 1972. 142p. (AFCRL-72-442). NTIS.

The report studies the energization of electrons in a magnetoplasma by wave-particle interaction. Depending upon the refractive index of the plasma medium and the field parameters the wave particle interaction exhibits either synchronous or oscillatory behavior. Adopting dipole model of geomagnetic field and various plasma and field parameters the energization of electrons in the ionosphere and magnetosphere has been studied. Detailed computation of energy gain and time of energy oscillation has been carried out. An effort has been made to explain some of the ionospheric and magnetospheric phenomena in the light of these calculations. The role of effective electron collision frequency on the wave particle phenomena has been considered. The problem is reformulated to include the effect of finite collisions. Computation is carried out to display the effect of collisions. (auth)

30945 (AD-747487) RF BEACON GROUND STATIONS DISPERSIVE PHASE/DIFFERENTIAL DOPPLER MEASUREMENT SYSTEM. Final Technical Report, 19 August 1970–15 January 1972. Honey, R. W. (Electrac, Inc., Anaheim, Calif. (USA)). Mar 1972. Contract F30602-71-C-0022. 59p. (EI-7718; RADC-TR-72-151). NTIS.

In support of the SECEDE II barium release RF Beacon Test Series, Electrac, Inc., designed, fabricated, installed and operated on site, four Dispersive-Phase/Differential Doppler Measurement Systems. The experiment's primary purpose was to further the diagnostic objective of obtaining descriptive information about the barium ions produced in the test series. The cloud parameter to be measured was the integrated electron density along a line-of-sight as a function of the line's cloud penetration position. Of prime interest were integrated density striations. The report describes the measurement system, including design criteria and final configuration of the four systems as installed in the field. (auth)

30946 (AD-747507) REPORT OF THE JOINT SATELLITE STUDIES GROUP, FLORENCE MEETING, OCTOBER 1971. (Florence Univ. (Italy). Istituto di Onde Elettromagnetiche). May 1972. 62p. (JSSG-4(Add.); AFCRL-72-402). NTIS.

The report is a collection of papers concerned with total ionospheric electron content and satellite signal scintillation along with the related measurement methods and techniques. The papers were presented at the 1971 meeting of the Joint Satellite Studies Group in Florence, October 1971. (auth)

30947 (AD-748445) STUDY ON BREMSSTRAHLUNG RADIATION AND ITS IONIZING EFFECT IN THE LOWER IONOSPHERE. Singh, R. N. (Banaras Hindu Univ., Varanasi (India). Inst. of Tech.). Oct 1970. 76p. (AFCRL-72-530). NTIS.

The attenuation of precipitating electrons of energy $1 < E < 100$ keV in the lower ionosphere was studied. The profile of energy and flux attenuation in the ionosphere was calculated. The theory of binary collisions between electron and neutral particle is given; electron and ion were used to study the generation of bremsstrahlung photon flux in the lower ionosphere. With the help of the computed bremsstrahlung photon flux, the photoionization and the impact ionization of the ionospheric constituents in the lower ionosphere were studied. The effect of energy spectra of precipitating electrons on the electron–ion pair production rate was also considered. (auth)

30948 (AD-749882) PROJECTS IN SOLAR ECLIPSE PREDICTION, IONOSPHERIC REFLECTION PROPERTIES, IONOSPHERIC D-REGION DATA REDUCTION, AND MICROWAVE ACOUSTICS. Final Report, 20 March 1970–19 June 1972. Dieter, K.; O'Brien, J. V.; Whelan, L. A. Jr. (Dabcovich and Co., Inc., Bedford, Mass. (USA)). Jun 1972. Contract F19628-70-C-0237. 125p. (AFCRL-72-383). NTIS.

The report describes analysis and programming projects in astronomy, ionospheric physics, and microwave acoustics. (auth)

30949 (AD-750395) ANALYTIC MODEL FOR NUCLEAR INDUCED D-REGION CHEMISTRY. Final Report. Scheibe, M. (Mission Research Corp., Santa Barbara, Calif. (USA)). Oct 1972. Contract DASA01-71-C-0136. 103p. (MRC-R-24; DNA-2920-F). NTIS.

Analytic expressions are developed describing the behavior of the neutral and ion chemistry in the D region following a nuclear burst. The results obtained using these expressions are compared at various altitudes to the results given by a coupled reaction rate code which numerically solves the differential equations involved. The areas which need improvement are discussed. (auth)

30950 (AD-750483) COMPUTATION OF ION COLLECTION BY A LARGE ROCKET-MOUNTED MASS-SPECTROMETER PLATE AT A LARGE DRAWING-IN POTENTIAL. Final Report, 28 April 1971–30 Jun 1972. Parker, L. W. (Mount Auburn Research Associates Inc., Newton, Mass. (USA)). 30 Sep 1972. Contract F19628-71-C-0200. 49p. (AFCRL-72-524). NTIS.

Calculations of the ion current density at the central point of a charged mass-spectrometer plate mounted on a rocket were ex-

tended into the regime of very small Debye lengths. Since self-consistent solutions are numerically difficult to obtain in this regime (especially for large dimensionless drawing-in potentials), the investigation was carried out with the aid of a linearized-space-charge model. Use of the model provides a potential distribution characterized by a Debye-length-like parameter λ_H. The nature of the ion trajectories in the strong electric field is studied, and correlations between λ_H and the true Debye length are discussed. (auth)

30951 (AD-750609) NIGHT-SKY RADIANT STERANCE FROM 450 TO 2000 NANOMETERS. Vatsia, M. L.; Stich, U. K.; Dunlap, D. (Army Electronics Command, Fort Monmouth, N. J. (USA). Night Vision Lab.). Sep 1972. 41p. (ECOM-7022). NTIS.

A ground-based, 3-channel Fourier spectroradiometer with a wave-number resolution of 250/cm was used to measure night-sky spectral radiant sterance (radiance) in the 450- to 2000-nm wavelength region. The experimental sites were remote locations in Panama, United States, and Canada. Details of night-sky radiation measuring system, calibration equipment, and procedures for data acquisition and analysis are presented. A large number of night-sky radiant sterance spectra recorded under various types of nighttime meteorological environments and Moon phases are presented. The results are compared to measurements reported in the literature. The night-sky radiant sterance spectra presented in this work are unique in two respects: They cover the wide wavelength region from 450 to 2000 nm; and they were recorded under a large variety of nighttime, atmospheric, optical environments. (auth)

30952 (AD-750610) ATMOSPHERIC OPTICAL ENVIRONMENT. Vatsia, M. L. (Army Electronics Command, Fort Monmouth, N. J. (USA). Night Vision Lab.). Sep 1972. Contract DA-1-S-662709-D-617. 123p. (ECOM-7023). NTIS.

A knowledge of the fundamental optical properties of the terrestrial atmospheric environment is essential for solving various problems in the multidisciplinary field of visionics including the areas of vision, psychology, atmospheric physics, infrared physics, simulation, astrogeophysics, and electro-optical technology. The aim of the report is to generalize the recent work of the author and summarize the data from other worldwide sources published by the first quarter of the year 1972. The report included a treatment of the atmospheric radiation, the atmospheric transmission, and the transfer of contrast by the atmosphere. The fundamental characteristics of the daytime and nighttime radiation including some important recent measurements of the solar, twilight, and nightglow radiation spectra are presented. An extensive chapter on atmospheric transmission includes the fundamental properties of the terrestrial atmosphere and basic principles of atmospheric absorption and scattering. A fairly complete collection of the most important data on atmospheric transmittance in the 0.4 to 15 micrometers spectral region is presented. The effects of atmospheric turbulence on the propagation of imagery are described. A detailed analysis of the transfer of contrast by the atmosphere is presented, and its significance on the performance of electro-optical devices is emphasized. (auth)

30953 (AD-753081) DESCRIPTION AND EVALUATION OF THE BENT IONOSPHERIC MODEL. Volume I. Final Report, 28 June–27 October 1972. Bent, R. B.; Llewellyn, S. K.; Wallock, M. K. (DBA Systems, Inc., Melbourne, Fla. (USA)). Oct 1972. Contract F04701-72-C-0380. 143p. (SAMSO-TR-72-239(Vol.1)).

The study is directed towards evaluating a worldwide empirical ionospheric model by comparing it with electron content data obtained from Faraday rotation measurements. The results are intended to assist in the design and implementation of a satellite navigational system which depends on signal ranging and hence the delay effects due to the ionosphere. The worldwide ionospheric model is evaluated in detail and the mean, standard deviation and root mean square of the residuals are computed along with correlation coefficients and cumulative probability distributions. Model update procedures and results are discussed where the update data is obtained from 1 to 9 hours prior to evaluation. The results show the capability of the model to remove a high proportion of the ionospheric effects but the conclusions indicate that caution is needed in reading too much optimism into these overall values and imply that diurnal trends should be reviewed in detail. Certain update procedures considerably improve the ionospheric residual during periods of high ionospheric density. Recommendations for future study and implementation of a model into the system are discussed. (auth)

30954 (AD-753082) DESCRIPTION AND EVALUATION OF THE BENT IONOSPHERIC MODEL. Volume II. Bent, R. B.; Llewellyn, S. K.; Walloch, M. K. (DBA Systems, Inc., Melbourne, Fla. (USA)). Oct 1972. Contract F04701-72-C-0380. 233p. (SAMSO-TR-72-239(Vol.2)). NTIS.

Volume 2 contains the statistical data for the evaluation conditions which are listed in detail in Volume 1. Each page is self-explanatory and displays either the diurnal mean, standard deviation or RMS residual for each month and condition, or the corresponding cumulative probability distributions for the entire period. The results are quoted in electron content and group delay time at 16.0 MHz. (auth)

30955 (AD-753083) DESCRIPTION AND EVALUATION OF THE BENT IONOSPHERIC MODEL. Volume III. Bent, R. B.; Llewellyn, S. K.; Walloch, M. K. (DBA Systems, Inc., Melbourne, Fla. (USA)). Oct 1972. Contract F04701-72-C-0380. 300p. (SAMSO-TR-72-239(Vol.3)). NTIS.

Volume 3 contains the statistical data for the evaluation conditions which are listed in detail in Volume 1. Each page is self-explanatory and displays either the diurnal mean, standard deviation or RMS residual for each month and condition, or the corresponding cumulative probability distributions for the entire period. The results are quoted in electron content and group delay time at 1600 MHz. (auth)

30956 (AD-753707) ANALYSIS OF ELECTRON BEAM IRRADIATION OF THE UPPER ATMOSPHERE. Final Report, 15 February–14 September 1972. Bien, F. (Aerodyne Research, Inc., Burlington, Mass. (USA)). Sep 1972. Contract F30602-72-C-0271. 48p. (ARI-RR-11; RADC-TR-72-297). NTIS.

A study has been made of the physics and chemistry involved when energy is deposited into the upper atmosphere by electrons. Calculations have been made both of the size and shape of the electron interaction region and of the radiation intensity produced in that region. The results of the NASA artificial aurora experiment performed by Hess et al., in 1969 has been analyzed in this context. The emission produced from electron interaction with the atmosphere in the 3500 to 8000A region has been analyzed. The size and shape of the observed region have been calculated by fitting laboratory measurements to the Earth's exponential atmosphere, taking into account the geomagnetic field, and are attributed to prompt radiation from N_2^+ first negative, N_2 first positive, and O_2^+ first negative, as well as to the afterglow radiation from OI 5577A and 6300A emitters. The calculated time dependence of the afterglow signal was found to be consistent with observations. (auth)

30957 (AD-754244) ROCKETBORNE MEASUREMENTS OF IONOSPHERIC DISTURBANCES. Final Report, 1 July 1970–31 March 1972. Baker, K. D. 1 Oct 1972. Contract F19628-70-C-0302. 43p. (AFCRL-72-601). NTIS.

During the period July 1, 1970 to March 31, 1972 a total of 12 rocketborne payloads were used from various launch sites to investigate ionospheric disturbances. The payloads were instrumented to measure a wide scope of ionospheric parameters which included ionizing sources and effects of these upon the atmosphere. The report is a summary of each research program involved and a complete compilation of references and abstracts pertinent to this research contract. (auth)

30958 (AD-754252) IONOSPHERIC AND SOLAR RADIO STUDIES FOR DISTURBED CONDITIONS. Final Report, 1 September 1970–31 August 1972. Papagiannis, M. D.; Mendillo, M. (Boston Univ., Mass. (USA). Dept. of Astronomy). Nov 1972. Contract F19628-71-C-0027. 43p. (AFCRL-72-670). NTIS.

The purpose was to study the atmosphere, the ionosphere, and the magnetosphere of the Earth under disturbed conditions produced by enhanced solar activity. It also includes, therefore, the study of solar activity in the different regions of the spectrum with special emphasis in the radio domain. Data obtained with ground-based radio telescopes and satellites, together with related information concerning ionospheric parameters, magnetic field intensities, optical solar observations, etc., were used in the different projects under investigation, all of which have the common aim to gain a better understanding of the terrestrial disturbances caused by the active Sun. (auth)

30959 (AD-759018) DETERMINATION OF D-REGION ELECTRON DENSITY DISTRIBUTIONS FROM RADIO PROPAGATION DATA. Research Report, April 1971–September 1972. Shellman, C. H. (Naval Electronics Lab. Center, San Diego, Calif.). 23 Jan 1973. 64p. (NELC-TR-1856). NTIS.

A linear method of profile inversion for deducing electron-density distributions is described along with an error analysis to assess accuracy of the resulting distributions. Examples are given of use with both steep-incidence and long-path types of data. Techniques of using elf sferics data are discussed. Appropriate background material is also given. (auth)

30960 (AD-759543) HIGH-ALTITUDE PLASMA EFFECTS. Parametric Excitation by an Electromagnetic Pump in a Large Laboratory Plasma (QUIPS: Quiescent Plasma Studies): First Results. Interim Report, 21 July 1972–31 July 1973. Arnush, D.; Fried, B. D.; Kennel, C. F.; Stanzel, R. L.; Wong, A. Y. (TRW Systems Group, Redondo Beach, Calif.). Feb 1973. Contract F30602-72-C-0304. 41p. (TRW-21961-6005; RADC-TR-73-128). NTIS.

A series of experiments are being carried out in the TRW large volume plasma facility, the QUIPS (Quiescent Plasma Studies) device. The purpose of the experiments is to study those parametric instabilities which are excited when high power microwaves propagate into a plasma cutoff region. The plasma instabilities have been observed with probes; in later experiments, Thompson radar scattering diagnostics will also be used. A variety of nonlinear effects which are consistent with the standard linear theory of parametric instabilities were observed, as well as other phenomena which are still the subject of theoretical study. The experimental results are grouped into the following topics: Parametric excitation of high frequency sidebands near the pump frequency; Excitation of low frequency oscillations; Propagation of ion acoustic waves in the presence of an electromagnetic wave pump; and Mode coupling of electron plasma waves and ion acoustic waves by an electromagnetic wave pump. (NTIS)

30961 (AD-760138) HEAVY PARTICLE INDUCED IONIZATION RATES FOR PCA 69. Sellers, B.; Hanser, F. A.; Huner-wadel, J. L. (Panametrics, Inc., Waltham, Mass.). Nov 1972. Contract F19628-71-C-0086. 69p. (AFCRL-72-650). NTIS.

During Operation PCA 69 proton and alpha particle fluxes in the approximate range 2 to 100 MeV were determined from measurements made on three Black Brant rockets launched at the following universal times: AJ17.602, 2 Nov/2020; AJ17.758, 3 Nov/0605; AJ17.617, 4 Nov/2308. General details of the particle detection system design are given, and the method of deducing the differential spectrum incident on the atmosphere from the measured altitude variation of the integral flux is discussed. Specific ionization rate expressions are derived for heavy particle spectra of the form $j(E,\alpha) \sim E^{-n} \cos^{\delta}$ of alpha and presented in a manner applicable to any atmosphere. When the spectrum is assumed to extend to infinite energy, a simple analytic result is obtained that is applicable to that region of the atmosphere in which the atmospheric depth exceeds the range of the minimum energy particles contained in $j(E,\alpha)$. Altitude profiles of proton induced ionization rate are given for the launch time of each of the three rockets. (auth)

30962 (ADP-115) STUDIES OF D-REGION DRIFTS DURING THE WINTERS OF 1970 TO 1972. Stubbs, T. J.; Vincent, R. A. (Adelaide Univ. (Australia). Dept. of Physics). Mar 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

Partially reflected radio waves were used to study D-region drifts in the midwinter month of July for the years 1970–72. The drifts are shown to agree well with wind estimates at similar heights obtained using meteor radar techniques. Additionally, the drifts exhibit behavior consistent with a strong tidal influence. The nature of these tides is discussed with emphasis on phase and amplitude variations with time and height. The monthly mean drift profiles are compared with wind models and the expected zonal drift profile particularly well reproduced. No evidence is found for any anomalous winter behavior by the drifts. (auth)

30963 SIMULTANEOUS GROWTH OF HIGH-LATITUDE POSITIVE BAY AND DR-FIELD IN THE COURSE OF PROTON AURORA SUBSTORM. Kamide, Y.; Fukunishi, H. (Tokyo Univ.). J. Atmos. Terrest, Phys.; 35: No. 11, 2085-2090(Nov 1973).

The simultaneous development of the high-latitude positive bay and the ring-current field is found with the proton aurora in the evening sector, all of which are attributable to the drifting protons associated with magnetospheric substorm. The sign of ΔZ (the deviation from the quiet level) is dependent on whether the geomagnetic station, where the positive H-bay is observed, is on the pole side of the most active region of the proton aurora or on the equator side. The order of magnitude of the positive bay is reasonably explained by an enhancement of the ionospheric conductivity due to the proton precipitation with the suitable energy flux. It is suggested that the positive bay is produced by the eastward electrojet possibly connected with the partial ring current in the magnetosphere. (auth)

30964 IONOSPHERIC EFFECTS DURING THE PARTIAL SOLAR ECLIPSE OF 10 JULY 1972. Soicher, H.; Gorman, F. J. Jr. (Army Electronics Lab., Fort Monmouth, NJ). Planet. Space Sci.; 21: No. 10, 1799-1801(Oct 1973).

Polarization measurements at Fort Monmouth, N. J., using ATS-3 emitted signals and bottomside ionospheric sounding measurements at the subionospheric point were performed during the partial solar eclipse of 10 July 1972. A decrease in the total electron content and the plasma temperature ensued with corresponding diffusive particle fluxes into heights of maximum ionization was comparable to the recombination rate at that altitude. (auth)

30965 ENHANCEMENT OF THE EQUATORIAL ANOMALY IN THE TOPSIDE IONOSPHERE DURING MAGNETIC STORMS. Raghavarao, R.; Sivaraman, M. R. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest, Phys.; 35: No. 11, 2091-2095(Nov 1973).

Alouette ionograms were used to obtain latitudinal variations of the topside electron density through the equatorial anomaly region at American longitudes during eight magnetic-storm events. Seven of the events showed enhancements of the anomaly compared to that observed during magnetically quiet conditions. The events analyzed related to different phases of the magnetic storms as well as to different local times. (auth)

30966 LOW-ENERGY ELECTRONS IN THE IONOSPHERE AS A NEW SOURCE OF ELECTROMAGNETIC WAVES IN THE VERY LOW FREQUENCY RANGE. Vershinin, E. F.; Gorshkov, Yu.N.; Ponomarev, E. A.; Trakhtengerts, V. Yu.; Shapaev, V. I. Dokl. Akad. Nauk SSSR; 210: No. 3, 563-566(21 May 1973). (In Russian).

One of the sources of epithermal electrons with energies < 300 MeV but > 10 MeV are electrons occurring in the process of photoionization at heights h_0 = 150 to 300 km. This electron flux can excite low-frequency electromagnetic or plasma radiation. An expression is given for the distribution of plasma waves of low-frequency. A beam of low-energy particles with this distribution can excite high-frequency plasma resonances. An amplification factor of 10 is necessary to explain the intensity of the low-frequency radiation noise at ionospheric heights. For typical ionospheric conditions and 30 MeV electrons the electron flux should be 5×10^7 to 5×10^{-8} cm^{-2} sec^{-1}. According to satellite observations, photoelectron fluxes of about 10^8 cm^{-2} sec^{-1} are rather typical at heights of 500 to 2000 km. (SJR)

30967 BEHAVIOUR OF THE UPPER IONOSPHERE OVER NORTH AMERICA AT SUNSET. Eccles, D.; Burge, J. D. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys.; 35: No. 11, 1927-1934(Nov 1973).

It is shown that the evening enhancements of electron concentration observed at Millstone Hill (43°N, 72°W) are not caused by a decrease in the electron temperature, but are a consequence of thermospheric winds. Very little effect is produced at the F-layer peak by the rapid decrease in electron temperature at sunset, but above the peak the electron temperature collapse is accompanied by a redistribution of the ionization in such a way that the enhancement produced by the winds occurs approx. 1½ h earlier at 600 km than it does near the layer peak. The sudden increase in the downward drift velocity observed near sunset results from the decay of the F layer and is thus not caused by the electron temperature collapse. (auth)

30968 EXPERIMENTAL TEST OF WIND-SHEAR THEORY. Do Rocket Borne Magnetometers Measure B? Whitehead, J. D. (Queensland Univ., St. Lucia, Australia). Planet. 'Space Sci.; 21: No. 10, 1815-1816(Oct 1973).

Recent measurements of electron density, magnetic field, and wind do not seem to be self-consistent and are unacceptable as an experimental test of the wind-shear theory. (auth)

30969 EXPERIMENTAL TEST OF THE WIND-SHEAR THEORY. A Reply: Rocket-Borne Magnetometers Do Measure B. Hall, S. H. (Queensland Univ., St. Lucia, Australia); MacKenzie, E. C. Planet. Space Sci.; 21: No. 10, 1817-1819(Oct 1973).

The apparent inconsistencies noted by Whitehead (Planet. Space Sci.; 21: 1815 (1973)) in the ionization, electron density, wind and magnetic field data of the rocket flights SL 130 and 131 (Hall et al. (Planet. Space Sci.; 19: 1319 (1971)) are resolved by the presentation of further experimental detail. Observational accuracy and in particular the heading correction procedure for the magnetic field values are discussed. It is also pointed out that the interaction of the steady E–W wind component with the E_s ionization profile provides an additional contribution to the E_s magnetic field. It is concluded that within the experimental limitations the experiment remains a fair test of the wind-shear theory. (auth)

30970 NORMAL E- AND F-LAYERS. Bates, D. R. (Queen's Univ., Belfast). J. Atmos. Terrest. Phys.; 35: No. 11, 1935-1952 (Nov 1973).

An account is given of the historical development of our knowledge of the normal E and F layers. Aspects covered include the formation of the layers, the collision processes, and the S and L geomagnetic variations. (auth)

30971 SLAB THICKNESS OF THE MID-LATITUDE IONOSPHERE. Titheridge, J. E. (Univ. of Auckland, New Zealand). Planet. Space Sci.; 21: No. 10, 1775-1793(Oct 1973).

The thickness of the peak of the ionosphere depends primarily on the temperature T_n of the neutral gas, and corresponds approximately to an α-Chapman layer at a temperature of $0{\cdot}87T_n$. The overall slab thickness, as given by Faraday rotation measurements, is then $\tau = 0.22T_n + 7$ km. Expansion of the topside ionosphere, and changes in the E and Fl regions increase τ by about 20 km during the day in summer. Near solar minimum τ is increased by a lowering of the O^+/H^+ transition height; if the neutral temperature T_n is estimated, this height can be obtained from observed values of τ. Hourly values of slab thickness were determined over a period of 6 yr and 34°S and 42°S. Near solar maximum the night-time values were about 260 km in all seasons. The corresponding neutral temperatures agree with satellite drag values; they show a semiannual variation of 14% and a seasonal change of 5%. Daytime values of τ were about 230 km in winter and 320 km in summer, implying a seasonal change of 30% in T_n. Temperatures increase steadily throughout the day in all seasons, with a rapid post-sunset cooling in summer. Downwards movements produce a large peak in τ at 0600 hr in winter. A large upwards flux, equal to about 40% of the maximum (limiting) value, reduces τ for several hours after sunrise in winter. The slab thickness increases near solar minimum showing a reduction of the O^+/H^+ transition height to about 700 km in summer and 500 km in winter. (auth)

30972 LARGE SCALE VERTICAL MOVEMENTS OF THE F-LAYER AND ITS EFFECTS ON THE TOTAL ELECTRON CONTENT OVER LOW LATITUDE DURING THE MAGNETIC STORM OF 25 MAY 1967. Low, N. C.; Roelofs, T. H. (Univ. of Hawaii, Honolulu). Planet. Space Sci.; 21: No. 10, 1805-1810 (Oct 1973).

Simultaneous observations of Doppler frequency shifts and the rate of change of total electron content (TEC) associated with the large magnetic storm of 25 May 1967 suggest that equatorward winds and semi-turbulent mixing of the thermosphere are important mechanisms responsible for the behavior of the disturbed ionosphere. A 2:1 ratio is observed in the frequency shifts of the 10 MHz and 5 MHz WWVH signals. This indicates that the cause of the shift is the vertical movement of the layer rather than changes in the ionization profile below the reflection height. The 100% increase in TEC during the first day of the storm is attributed to the equatorial wind which raises the F layer to higher altitudes where the loss rate is smaller. The 60% depression of TEC on the second day is attributed to the semi-turbulent mixing process of the thermosphere. (auth)

30973 STORM-TIME CHARACTERISTICS OF LOW-ALTITUDE WHISTLERS. Tanaka, Y.; Hayakawa, M. (Nagoya Univ., Japan). Planet. Space Sci.; 21: No. 10, 1797-1798(Oct 1973).

Using the results from special observations, the storm-time effects on whistler characteristics at low latitudes were examined and found to agree with previous statistical studies. A short discussion is made on the link between spread-F irregularities and magnetospheric whistler ducts. The enhanced whistler activity is explained as a consequence of the stable whistler duct region during spread-F conditions. (auth)

30974 EXPERIMENTAL INVESTIGATIONS OF SCHUMANN RESONANCE FREQUENCIES. Sao, K.; Yamashita, M.; Tanahashi, S.; Jindoh, H.; Ohta, K. (Nagoya Univ., Japan). J. Atmos. Terrest. Phys.; 35: No. 11, 2047-2053(Nov 1973).

The Schumann cavity resonances are excited by thunderstorms in the Earth–ionosphere cavity. There are, however, many cases in which data analyses are difficult because of the world-wide nature of the phenomenon. A description is given of the results of observations made by the use of a solenoidal coil antenna. Day-to-day variations of the resonance frequency and the averaged diurnal variations are discussed with regard to solar ionizing radiation, solar zenith angle, and geomagnetic disturbances. (auth)

30975 INCREASE OF THE INTENSITY OF THE SOLAR PROTONS IN JULY 1970. Pereslegina, N. V.; Pyubimov, G. P. Kosm. Issled.; 11: No. 2, 236-244(1973). (In Russian).

The increase of the proton intensity with energy greater than 10 MeV, injected by some solar flares of one active region, was examined. It was shown that the quasistationary corpuscular beam from this active region was significantly affected in the propagation of the flare protons and the collision wave. (tr-auth)

30976 INVESTIGATION OF THE IONOSPHERE CARRIED OUT BY MEANS OF THE INTERKOSMOS-2 SATELLITE. II. Investigation of the Equatorial Anomaly of the F Region. Gdalevich, G. L.; Gorozhankin, B. N.; Kutiev, I. S.; Samardzhiev, D. T.; Serafimov, K. B. Kosm. Issled.; 11: No. 2, 245-253(1973). (In Russian).

By means of three-electrode ion trap the distribution of the ion concentration in the equatorial region was obtained by measurements on Interkosmos-2 in the period from December 30, 1969, to January 20, 1970. The equatorial anomaly appeared at altitudes of 200 to 500 km in the day and from 800 to 1200 km at night. In the night ionosphere at altitudes above 900 km a minimum near the geomagnetic equator was observed in the wide distribution of the concentration of positive ions. (tr-auth)

30977 INVESTIGATION OF THE IONOSPHERE CARRIED OUT BY MEANS OF THE INTERKOSMOS-2 SATELLITE. III. Measurement of the Electron Temperature in the Ionosphere by the Method of High-Frequency Probes. Afonin, V. V.; Gdalevich, G. L.; Gringauz, K. I.; Kainarova, Ya.; Shmilauer, Ya. Kosm. Issled.; 11: No. 2, 254-266(1973). (In Russian).

A method for temperature measurement of electrons T_e with high-frequency probes was examined. An analytical expression for the measurement magnitudes of the melting potential with consideration of the form of the volt-ampere characteristics of the probe and of the input resistance of the meter was derived. The results were reported of the measurement of T_e by Interkosmos-2 during January and February 1970. At altitudes of 600 to 1200 km at medium latitudes the night value of T_e is in the interval from 1200 to 1600°K and the day value at 2500 to 3500°K. The predawn effect of the increase of T_e, caused by the beam of photoelectrons from the correlated region of the ionosphere, begins to appear at mean values of the zenith angle of the Sun in the correlated region ~103°. (tr-auth)

30978 INVESTIGATION OF THE IONOSPHERE CARRIED OUT BY MEANS OF THE INTERKOSMOS-2 SATELLITE. IV. Measurements by Means of Cylindrical Langmuir Probes. Bishoff, K.; Gdalsvich, G. L.; Gubskii, V. F.; Dmitrieva, I. D.; Tsammerman, G. Kosm. Issled.; 11: No. 2, 267-272(1973). (In Russian).

The results of the measurement of the concentration and temperature of electrons with two cylindrical Langmuir probes oriented perpendicularly to each other at altitudes of 200 to 1000 km were reported. It was shown that the magnetic field does not affect the size of the measured concentration and temperature of the electrons. A comparison was made of the results of the measurement of the concentration of charged particles with Langmuir probes and spherical ion traps and the measurement of the temperature of electrons with Langmuir probes and high-frequency probes. (tr-auth)

30979 ROCKET MEASUREMENT OF THE ION COMPOSITION. Zhlud'ko, A. D. Kosm. Issled.; 11: No. 2, 297-305(1973). (In Russian).

The results of the rocket mass-spectrometric measurement of the ion composition of the atmosphere at altitudes from 100 to 270 km at medium latitudes and the measurement of ions at altitudes from 100 to 170 km in the polar regions were reported. Simultaneously with the mass-spectrometric measurements in the ionosphere, experiments were made on the study of the effect of the ionization of H_2O and D_2O water vapor with atmospheric agents. It was established that during the ionization of H_2O water vapor the positive ions 18^+ (H_2O^+) and 19^+ (H_3O^+) were formed, but during the ionization of D_2O the ions 20^+ (D_2O^+), 21^+ (HD_2O^+), and 22^+ (D_3O^+) appeared. The transient pattern of the process of the desorption of moisture with the surface of the rocket was determined from the data obtained. The intense ionization of the water vapor was observed at altitudes of the F region both in the daytime and the nighttime. (tr-auth)

30980 SOME RESULTS OF THE MEASUREMENT OF THE PARAMETERS OF THE INHOMOGENEITY OF THE ELECTRON COMPONENT OF THE IONOSPHERE ON THE KOSMOS-381 SATELLITE. Getmantsev, G. G.; Komrakov, G. P.; Ivanov, V. P.; Popkov, I. V.; Tyukin, V. N. Kosm. Issled.; 11: No. 2, 335-338(1973). (In Russian).

The inhomogeneity of the electron component of the ionosphere was measured at altitudes not exceeding 1000 km by a high-frequency impedance probe on the Kosmos-381. The inhomogeneities were classified according to size. The results are shown graphically. (tr-auth)

30981 RADIATION DOSES DURING PROLONGED ORBITAL FLIGHT IN SPACE NEAR THE EARTH. Vernov, S. N.; Savenko, I. A.; Savun, O. I.; Senchuro, I. N.; Shavrin, P. I. Kosm. Issled.; 11: No. 2, 321-328(1973). (In Russian).

On the basis of multiyear measurement of the penetrating radiation on Soviet cosmic devices conclusions were made on the degree of radiation danger during prolonged piloted flight in orbits with apogee at ~300 km and with an inclination ≤65° in space ships,

whose construction shield thickness is not less than 3 g/cm^2. The total absorbed dose of radiation inside the space ship from the effects of the radiation belt, cosmic radiation, and protons of solar flares in years of maximum and minimum solar activity were reported. (tr-auth)

30982 PLASMA WAVES ARTIFICIALLY INDUCED IN THE IONOSPHERE. Jones, T.W.; Kellogg, P.J. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota, 55455). J. Geophys. Res. 78: No. 13, 2166-2175 (1 May 1973).

Calculations of the growth of instabilities generated by a 40-kev, 0.1-amp electron beam fired perpendicular to the magnetic field in the earth's ionosphere are presented. In general the amount of growth is small. These calculations were made to predict the results of a University of Minnesota experiment and are consistent with the observations. (auth)

30983 TWIN PAYLOAD OBSERVATIONS OF INCIDENT AND BACKSCATTERED AURORAL ELECTRONS. Reasoner, D.L.; Chappell, C.R. (Lockheed Palo Alto Research Laboratory, Palo Alto, California, 94304). J. Geophys. Res. 78: No. 13, 2176-2186 (1 May 1973).

Energy spectra and pitch angle distributions of auroral electrons have been measured in a premidnight multiple arc auroral display by a Javelin rocket containing two identical payloads that separated in flight. The rocket (code-named Twins 2) was launched from Fort Churchill, Canada, at 0459 UT on March 2, 1968, and covered an altitude range up to 800 km. The electron energy spectra between 40 ev and 20 kev show a 'continuum' spectrum with a superimposed energetic peak. The center energy of the peak was observed to shift from 10–12 kev over the arcs to 2–3 kev between the arcs. This spectra structure is shown to be similar to the inverted 'V' structure reported by other investigators. The in flight separation of the two payloads allowed investigation of spatial versus temporal effects in the auroral precipitation. In one interval of the flight an arc was observed to be moving northward with a velocity of 0.6 km/sec. Calculated backscattered spectra are compared with those actually measured. Good agreement was observed for electron energies above about 1.5 kev, but below this energy the backscatter ratio was observed to be ≈100%. Several explanations for this unusually high ratio are considered, and a likely possibility is shown to be a parallel downward-directed electric field between ≈150 and 500 km. (auth)

30984 AURORAL ELECTRONS OF ENERGY LESS THAN 1 KEV OBSERVED AT ROCKET ALTITUDES. Arnoldy, R.L. (Space Science Center, University of New Hampshire, Durham, New Hampshire, 03824); Choy, L.W. J. Geophys. Res. 78: No. 13, 2187-2200 (1 May 1973).

Measurements of electrons of energy less than 1 kev in the auroral precipitation with detectors aboard three rocket flights are discussed. Detectors simultaneously measured the flux of electrons moving up and down the magnetic field lines. Electrons of energy less than a few hundred electron volts show directional intensities ranging from isotropic over the upper hemisphere, to field aligned into the atmosphere, to a net streaming out of the atmosphere. Cases of reflection coefficients greater than 1 for the few hundred electron volts and lower-energy electrons occur when measurements were made north of auroral forms. These electrons might represent the high-energy tail of the return Birkeland currents. The origin of the low-energy electrons is itself in question. The altitude dependence is not strong enough to suggest that they are primaries and their spectral shape is much flatter than calculated secondary spectra. The few hundred electron volt electrons do show a strong dependence on the integrated primary spectrum above atmospheric cutoff. This, along with their variable directionality, suggests that they are secondaries that have been locally heated or accelerated. (auth)

30985 SPLIT LANGMUIR PROBE MEASUREMENTS OF CURRENT DENSITY AND ELECTRIC FIELDS IN AN AURORA. Bering, E.A. (Physics Department and Space Sciences Laboratory, University of California, Berkeley, California, 94720); Kelley, M.C.; Mozer, F.S. J. Geophys. Res. 78: No. 13, 2201-2213 (1 May 1973).

A split Langmuir probe instrument was flown on a Black Brant VB sounding rocket from Fort Churchill into an auroral event at a time near local midnight on August 2, 1968. The split Langmuir probe consisted of two conducting plates that were separated by a thin insulator and that were simultaneously swept from negative to positive potentials with respect to the plasma. By measuring the current to each plate and the difference current between plates as a function of the sweep voltage, information was obtained on the plasma current density bulk flow, electron temperature and density. Perturbations due to wake effects, work functions, and probe contamination prevented complete measurement of all of these parameters. Upper limits on the ion current parallel to B in the frame of reference fixed to the earth of $\pm 5\times10^{-6}$ amp/m^2 and on the electron current parallel to B of $\pm 8\times10^{-4}$ amp/m^2 were obtained. The perpendicular electric field deduced from measurements of the ion bulk flow was in general agreement with independent results from a double probe electric field detector flown on the same rocket. The density and temperature measurements exhibited features consistent with expectations based on electric field, particle, and all-sky camera data. The upper limits on the parallel ion and electron currents were smaller than values required for the formation of free sheaths in a plasma of the measured density and temperature. Hence the parallel electric field of 20 mv/m reported on the same flight by Kelley, Mozer, and Fahleson (1971) must have been sustained by spatially diffuse regions of anomalous resistivity, and not by free sheaths. (auth)

30986 ELECTRIC FIELD AND PLASMA DENSITY OSCILLATIONS DUE TO THE HIGH-FREQUENCY HALL CURRENT TWO-STREAM INSTABILITY IN THE AURORAL E REGION. Kelley, M.C. (Space Science Laboratory, University of California, Berkeley, California, 94720); Mozer, F.S. J. Geophys. Res. 78: No. 13, 2214-2221 (1 May 1973).

Observations of oscillating electric fields and plasma density fluctuations have been made in the E region of the earth's auroral ionosphere during a major magnetospheric substorm. By means of double probe and barium cloud measurements of the ambient dc electric field and Langmuir probe measurements of the plasma density, the plasma was known to be unstable to the high-frequency Hall current two-stream instability. The altitude range, frequency dependence, polarization, and amplitude of the fluctuations were in excellent agreement with the theory for this instability. In addition, simultaneous measurements of the plasma density and electric field fluctuations allowed determination of the real part of the dispersion relation at low frequencies. The waves were found to proagate with no dispersion at a velocity of about 500 m/sec in a reference frame fixed to the earth, a result consistent with an acoustic wave explanation for the phenomenon and implying that nonlinear effects stabilize the wave at a speed less than the electron streaming velocity. (auth)

30987 PHASE VELOCITIES OF IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Cohen, R. (Aeronomy Laboratory, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, Boulder, Colorado, 80302). J. Geophys. Res. 78: No. 13, 2222-2231 (1 May 1973).

Spectral decomposition of the power spectrum of radar echoes at 50 MHz from the equatorial electrojet reveals information as to the phase velocities of several classes of electron density irregularities and permits inferences as to the electron drift velocity and the electron and ion temperatures in the electrojet. In particular, it is shown that the phase velocity of two-stream irregularities is comparable to the ion-acoustic speed and independent of the horizontal phase velocity of coexistent non-two-stream irregularities. The latter can exceed the ion-acoustic speed and is probably a measure of the electron drift velocity. Thus a probable inference is that the electron drift velocity can itself be supersonic, contrary to some existing theoretical opinions. The results suggest that there are frequently two or more strata containing non-two-stream irregularities moving at different mean phase velocities. Identification of the phase velocity of the two-stream irregularities with the ion acoustic speed leads to the conclusion that the electron and ion temperatures in the electrojet are comparable, in agreement with incoherent scatter observations of the E region at other lattides. Thus, these results tend to refute rocket measurements made by Langmuir probes in the electrojet. (auth)

30988 UNIFIED THEORY OF TYPE I AND II IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Sato, T. (Aeronomy Laboratory, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, Boulder, Colorado, 80302). J. Geophys. Res. 78: No. 13, 2232-2243 (1 May 1973).

Turbulent structure of the electrojet is discussed in detail, and a unified interpretation of the electroject irregularities (type I and type II) is given in terms of nonlinear two-stream and cross field instabilities. It is emphasized that small-scale type II irregularities (3≈15 meters) can be interpreted as resulting from nonlinear decay (collapse) of large-scale irregularities (≈150 meters), which are directly excited by the cross field instability. It is shown that polarization fields associated with the large irregularities modify the straight (horizontal) electron flow substantially; electrons are constrained to make periodic excursions vertically upward and downward in accord with the period of the irregularities. Consequently, the type I irregularities arising from the two-stream instability are excited obliquely and vertically, as well as horizontally. It is also shown that the observed constant phase velocity of the type I irregularities can be explained in terms of the quasilinear stabilization. In addition, it is emphasized that one should not regard the mean Doppler velocity of the type II (3-meter) echoes $V_{ph3}{}^{II}$ as representing the electron drift velocity when type I echoes coexist, i.e., when $V_{ph3}{}^{II} > C_s$, where C_s is the ion sound velocity. (auth)

30989 IONOSPHERIC STRUCTURE NEAR THE DAYSIDE BOUNDARY OF CLOSED FIELD LINES. Hrulka, A.; McDiarmid, I.B.; Burrows, J.R. (Division of Physics, National Research Council, Ottawa, Ontario, Canada). J. Geophys. Res. 78: No. 13, 2311-2314 (1 May 1973).

Variations of ionospheric electron density at altitudes of ≳600 km in the vicinity of the boundary of closed field lines are described. Ionospheric densities are determined from the Isis 1 swept frequency sounder data; the locations of the boundary are determined from latitude profiles of counting rates of electrons (E > 20 kev). Ionospheric densities at all altitudes decrease around the boundary and are low in the polar ionosphere, usually during geomagnetic storms. A trough in ionospheric density at altitudes of ≲1000 km, centered on the boundary field lines, is often observed and is always associated with a peak of density at altitudes of ≳1400 km centered on the same field lines. When there are no systematic changes below 1000 km near the boundary, the density above 1400 km either changes randomly or increases at and poleward of the boundary. (auth)

30990 ON THE CAUSE OF EQUATORIAL SPREAD F. (Hanson, W. B.; McClure, J. P.; Sterling, D. L. (University of Texas at Dallas, Dallas, Texas, 75230). J. Geophys. Res.; 78: No. 13, 2353-2356(1 May 1973).

It is suggested that convective electric fields in the equatorial ionosphere are generated by neutral winds (either zonal or meridional) acting on regions having structure in their field aligned Pedersen conductivity integrals. The conductivity structure is presumed to be caused by long-lived metallic ions that have been concentrated irregularly below the F layer at altitudes where their collision and gyrofrequencies are comparable. The resulting plasma convection leads to large-scale (>10 km) irregularities and sets up gradients in the electric field and/or plasma pressure that drive other instability mechanisms to produce smaller-scale irregularities. (WDM)

30991 SEASONAL AND SUNSPOT CYCLE VARIATIONS OF F REGION ELECTRON TEMPERATURES AND PROTONOSPHERIC HEAT FLUXES. Evans, J. V. (Lincoln Laboratory, MIT, Lexington, Massachusetts, 02173). J. Geophys. Res.; 78: No. 13, 2344-2349(1 May 1973).

The F region electron temperatures observed at Millstone Hill were averaged to obtain the daytime (1000-1500 EST) and nighttime (2100-0300 EST) monthly average values for a 4½-year period (January 1964 through June 1968). A clear seasonal variation was found with summer daytime temperatures at 300 and 500 km, exceeding winter temperatures by an amount that increases with increasing sunspot activity. By contrast, the nighttime temperatures are greatest in winter and exhibit no sunspot cycle variation. The average daytime heat flux from the magnetosphere was derived from these results and exhibited a clear trend of increasing with rising sunspot number. On the average, the daytime heat fluxes were 40% larger in winter than in summer. This variation is shown to be much greater than is expected on the basis of the observed change in the temperature of the (F region) heat sink alone. It was concluded that there is an annual variation in the temperature of the magnetosphere and that possibly this is brought about by an asymmetry in the photoelectron escape from northern and southern hemispheres. (WDM)

Effects of Nuclear Detonations

30992 (AD-741707) CHEMISTRY OF NITROGEN OXIDES AND OZONE IN THE DISTURBED D-REGION. Ory, H. A.; Gilmore, F. R. (R and D Associates, Santa Monica, Calif. (USA)). Sep 1971. Contract DASA01-71-C-0103. 24p. NTIS.

Chemical kinetic calculations are presented which describe the chemistry of nitrogen oxides and ozone in D-region air bombarded by an intense pulse of x rays as would be produced by nuclear explosions. Relatively latetime behavior is emphasized; early deionization processes are treated in a summary fashion. Special attention is given to the reactions of excited species, which have not been included previously, but which greatly affect the yields of NO, NO_2, and O_3. Results are given for various altitudes, bombardment intensities, and both day and night conditions. The reactions that mainly control the chemistry are identified, and the effects of the excited species are summarized. (auth)

Magnetospheric Phenomena

Refer also to abstracts 30870 and 30900.

30993 (AD-747092) GENERATION AND PROPAGATION OF LOW FREQUENCY ELECTROMAGNETIC WAVES. Scientific Report No. 3. Singh, R. N. (Banaras Hindu Univ., Varanasi (India). Inst. of Tech.). Dec 1971. 95p. (AFCRL-72-441). NTIS.

The general theory of energy attenuation of a test charge particle in a cold and collisional plasma has been developed. The effects of collisions on plasma parameters have been brought about. The radiation characteristics of spiraling test particles are discussed. In presence of collisions it is found that absorption is associated with radiation. Estimates of radiated and absorbed power by test charges of different energies have been made and the role of collision on the power spectrum has been studied. These effects are shown with the help of various graphs. The propagation of vlf waves radiated by Cherenkov process, specially in the whistler mode, is discussed. (GRA)

30994 (AD-747094) NATURAL GENERATION OF ELECTROMAGNETIC WAVES AND INTERACTION WITH MEDIA. Progress Report No. 7, 1 September–30 November 1971. Singh, R. N. (Banaras Hindu Univ., Varanasi (India). Inst. of Tech.). Dec 1971. 31p. (AFCRL-72-443). NTIS.

The heating of the electron component of a magnetoplasma due to localized time varying magnetic field perturbations has been studied by solving the relevant Boltzmann transport equation. The variation in electron temperature with pitch angle in chosen plasma models has been studied. The change in electron temperature with perturbation time in each of the plasma models has been shown. It is argued that these results may be helpful in interpreting and analyzing some observed geophysical and astrophysical features. (GRA)

30995 (AD-748444) STUDY ON HEATING OF ELECTRON PLASMA BY ELECTRIC FIELD MAGNETIC FIELD AND ELECTROMAGNETIC WAVE PERTURBATIONS. Singh, R. N. (Banaras Hindu Univ., Varanasi (India). Inst. of Tech.). Sep 1970. 57p. (AFCRL-72-529). NTIS.

The perturbation in the velocity distribution function by the application of magnetic field, electric and electromagnetic field perturbation has been studied. Boltzmann transport equations are solved to obtain the relevant perturbations in the velocity distribution function. The rate of change of electron energy with time is calculated for various field perturbations. The heating of electron component of the fully ionized and weakly ionized magnetoplasma has also been studied. The effect of propagating and localized magnetic perturbation has been considered. Electron heating has been estimated for assumed magnitude and frequency of magnetic perturbation and magnetoplasma parameters. The study of localized electric field perturbation on the heating of electron component of the plasma has also been included. Adopting a simple model, the feasibility of devising a laboratory experiment for electron heating is discussed. (GRA)

30996 (AD-757901) NATURAL GENERATION OF ELECTROMAGNETIC WAVES AND INTERACTIONS WITH MEDIA. Final Report, 1 September 1969–31 August 1972. Singh, R. N. (Banaras Hindu Univ., Varanasi (India). Inst. of Tech.). Oct 1972. 210p. (AFCRL-TR-73-93). NTIS.

The report describes in detail the electrical conductivity of the plasma, the effects of collisions, of static electric and magnetic fields, effects of plasma perturbations, the derivation of plasma conductivity from the Boltzmann equation, and nonlinear aspects of plasma conductivity. In subsequent sections, the electromagnetic wave radiations from accelerated electrons are classified into four main processes such as cyclotron- and Doppler-shifted cyclotron radiation. Cherenkov and synchrotron radiation are compared with each other. The wave generation by the Cherenkov process, atmospheric bremsstrahlung, plasma oscillation, ion acoustic waves, wave particle resonance and energization of charged particles are treated. Further work examines the heating of the electron gas by electric and magnetic fields, the role of pitch angle distribution in the heating mechanism and the heating of a magnetoplasma by oscillating fields. A section is devoted to the probing of inhomogeneous plasma by electromagnetic pulses. (GRA)

30997 SEASONAL AND SOLAR CYCLE DEPENDENCE OF THE POSITION OF THE CUSP REGION OF THE MAGNETOSPHERE. Deshpande, M. R. (Department of Scientific and Industrial Research, Christchurch, New Zealand). Nature (London) Phys. Sci.; 244: No. 137, 109-110(13 Aug 1973).

It is stated that satellite measurements have established the existence of two cusp regions (also called neutral points) on the dayside magnetosphere around ±75° corrected geomagnetic latitude, and it is believed that low-energy solar-wind particles penetrate to ionospheric heights from the cusp regions and give rise to various geophysical phenomena, that are summarized. An examination was made of the median monthly values of the F2 region critical frequency, f_0F_2, obtained with a number of polar ionosondes, and in most cases an enhancement was noted that peaked very close to local geomagnetic noon. The seasonal and solar cycle variations in this "noon enhancement" are derived, from which some properties of the cusp regions could be deduced. In general the magnitude

of the enhancement decreased, and its peak shifted towards the pole, with decreasing solar activity, and its magnitude was greatest during the equinoxes. It is thought possible that the greater equinoctial values may not be due solely to increased particle precipitation, and the equinoctial maximum in the atmospheric ratio of O to O_2 may be a contributory factor. It is concluded that the mean position of the cusps, and an indication of the mean energy and/or flux in the solar-wind particles precipitated through them, can be mapped from ground based ionosonde data. (UK)

30998 EXISTENCE OF GEOMAGNETICALLY TRAPPED ELECTRONS AT ALTITUDES BELOW THE INNER RADIATION BELT. Hayakawa, S.; Kato, T.; Kohno, T.; Murakami, T.; Nagase, F.; Nishimura, K.; Tanaka, Y. (Department of Physics, Nagoya University, Nagoya, Japan). J. Geophys. Res. 78: No. 13, 2341-2343 (1 May 1973).

The existence of suprathermal electrons below the lower boundary of the radiation belt in a geomagnetically quiet time was confirmed and it was found that above 500 km most of these electrons are trapped by the geomagnetic field. The observations covered the altitude range 200 to 800 km, with the L value ranging from 1.17 to 1.25. (WDM)

30999 OBSERVATION OF A CURRENT-DRIVEN PLASMA INSTABILITY AT THE OUTER-ZONE—PLASMA SHEET BOUNDARY. Scarf, F.L.; Fredricks, R.W. (Space Sciences Department, TRW Systems, Group, Redondo Beach, California, 90278); Russell, C.T.; Kivelson, M.; Neugebauer, M.; Chappell, C.R. J. Geophys. Res. 78: No. 13, 2150-2165 (1 May 1973).

Several spacecraft experimenters have reported on the detection of large temporal variations in trapped electron fluxes near $L \simeq 5$–6 at midlatitudes in the night hemisphere. In this report we describe in detail the particle, wave, and field changes measured when Ogo 5 traversed an outer-zone trapping boundary of this type on September 7, 1968. It is shown that thermal proton concentrations and $E > 50$-kev electron fluxes abruptly decreased when electrons with (1–4) kev mean energy were detected. It is also shown that currents flowed along the average geomagnetic field direction near the plasma boundaries and that these were accompanied by intense VLF electrostatic waves. It is proposed that turbulent resistivity produced by current-driven plasma instabilities allows parallel dc electric fields to develop along this boundary. Some measured changes in local proton temperature are discussed in terms of resistive heating, but it is noted that spacecraft charging phenomena might partially account for observed thermal shifts. (auth)

31000 FIELD-ALIGNED CURRENTS, PLASMA WAVES, AND ANOMALOUS RESISTIVITY IN THE DISTURBED POLAR CUSP. Fredricks, R.W.; Scarf, F.L. (Space Sciences Department, TRW Systems Group, Redondo Beach, California, 90278); Russell, C.T. J. Geophys. Res. 78: No. 13, 2133-2141 (1 May 1973).

During the magnetic storm of November 1, 1968, the Ogo 5 spacecraft encountered the polar cusp region at low magnetic latitudes. We show that the region just outside the last closed field lines contained a warm magnetosheath plasma, magnetic field perturbations interpretable as field-aligned current layers, and electrostatic waves possibly due to plasma instabilities driven by these currents. Estimates of anomalous resistivity extrapolated along the field lines due to these electrostatic waves lead to estimates of field-aligned potential drops between Ogo 5 ($\simeq 2R_E$) and the ionosphere on the order of 2 kv. Magnitudes of the field-aligned currents estimated from magnetic field perturbation signatures are approximately one-half of the total available thermal electron flux in the warm magnetosheath-type plasma as measured at Ogo 5. (auth)

31001 EQUILIBRIUM STRUCTURE OF RADIATION BELT ELECTRONS. Lyons, L.R. (Space Environment Laboratory, NOAA, Boulder, Colorado, 80302); Thorne, R.M. J. Geophys. Res. 78: No. 13, 2142-2149 (1 May 1973).

The detailed quiet time structure of energetic electrons in the earth's radiation belts is explained on the basis of a balance between pitch angle scattering loss and inward radial diffusion from an average outer zone source. Losses are attributed to a combination of classical Coulomb scattering at low L and whistler mode turbulent pitch angle diffusion throughout the outer plasmasphere. Radial diffusion is driven by substorm associated fluctuations of the magnetospheric convection electric field. (auth)

31002 GEOPHYSICAL PLASMA INSTABILITIES AND THEIR IMPORTANCE. Williams, D. J. (Space Environmental Lab., Boulder, CO). Comments Astrophys. Space Phys.; 5: No. 3, 57-65(1973).

Examples of potential plasma instabilities are presented and one is discussed in detail to illustrate roughly the combination of theory and observation required to identify the relevant instabilities and their evolution in space and time. (WDM)

31003 RADIATION PRODUCTION AND ENERGY DEPOSITION BY RING CURRENT PROTONS PRECIPITATED INTO THE MID-LATITUDE UPPER ATOMOSPHERE. Proelss, G. W. (Univ., Bonn). Planet. Space Sci.; 21: No. 10, 1681-1690(Oct 1973).

The radiation production and energy deposition by ring-current protons precipitated along magnetic-field lines into the mid latitude upper atmosphere is investigated. The loss of protons from the ring current by plasma instabilities is considered. The magnitude and sharpness of the atmospheric loss cone is determined. The behavior of the precipitated hydrogen particles in the denser atmosphere is studied using a Monte Carlo calculation. It is found that the energy deposition and radiation production will critically depend on how far the ring-current protons diffuse into the loss cone before being neutralized in the atmosphere; this in turn will depend on the strength of the plasma turbulence in the ring-current belt region. (auth)

31004 VLF INPUT IMPEDANCE OF A LOOP ANTENNA EMBEDDED IN THE MAGNETOSPHERE. Wang, T. N. C. (Stanford Research Inst., Menlo Park, CA); Chang, C. D. Planet. Space Sci.; 21: No. 10, 1810-1815(Oct 1973).

An analysis is made to calculate input impedance of a loop antenna for radiation of the vlf whistler mode in the magnetosphere. The magnetosphere is assumed to be represented by a cold, uniform and collisionless magnetoplasma medium. Assuming a uniform current distribution of a circular loop, oriented at an arbitrary angle with respect to the Earth's magnetic-field line, several closed-form expressions for the loop impedance have been derived. It is found that the loop input reactance is in substantial agreement with the self-inductance of a loop in free space and that the radiation resistance for a small loop can be as large as $\sim 10^2\ \Omega$. It is also found that a second order quasi-static theory is quite valid for determining the input impedance for small loops radiating vlf whistlers in the magnetosphere. (auth)

31005 VISCOUS INTERACTION AT THE SOLAR WIND-MAGNETOSPHERE BOUNDARY. Rajaram, R.; Kalra, G. L.; Tandon, J. N. (Univ. of Delhi). J. Atmos. Terrest. Phys.; 35: No. 11, 2069-2079(Nov 1973).

Wave reflection and stability of the magnetopause are considered, using Chew et al. (1956) equations to describe the magnetosphere and solar wind plasmas. The results are discussed with a view to account for a possible viscous interaction at the boundary. (auth)

31006 MAGNETOSPHERIC PLASMA MOTION DURING A SUDDEN COMMENCEMENT. Lin, C. A.; Young, D. T.; Wolf, R. A. (Rice Univ., Houston, TX). Planet. Space Sci.; 21: No. 10, 1713-1729(Oct 1973).

A sudden commencement occurred at 2348 UT on 15 February 1967, when the ATS-1 satellite was about 2 hr past local noon at the geocentric distance of $6 \cdot 6\ R_E$. Plasma was observed by the Suprathermal Ion Detector (SID) first to flow in the antisolar direction, as expected, but then to flow westward, for about 2 min, at about 50 km/sec. Analysis of ground magnetograms suggests that the surprising westward flow, which must have involved an electric field of about 10 mV/m at $6 \cdot 6\ R_E$, resulted from the ionosphere's reaction to the sudden commencement. Beginning about 2 min before the start of the westward flow at ATS-1, ground magnetometers near the foot of the ATS-1 field line typically recorded magnetic-field deflections of about 70 γ, to the northeast. No attempt is made in this paper to explain these ground observations. However, taking the ground observations, assuming a height-integrated Hall conductivity of 1 mho, and a standoff distance of $7 \cdot 2\ R_E$ inferred from Explorer 33 solar-wind data, a magnetospheric electric field is derived that agrees in magnitude and direction with that required to produce the observed flow at ATS-1. (auth)

31007 DETERMINATION OF WHISTLER NOSE-FREQUENCY AND MINIMUM GROUP DELAY AND ITS IMPLICATION FOR THE MEASUREMENT OF THE EAST-WEST ELECTRIC FIELD AND TUBE CONTENT IN THE MAGNETOSPHERE. Sagredo, J. L.; Smith, I. D.; Bullough, K. (Univ. of Sheffield, Eng.). J. Atmos. Terrest. Phys.; 35: No. 11, 2035-2046(Nov 1973).

The method of Dowden and Allcock (J. Atmos. Terr. Phys.; 33: 1125(1971)) for the determination of the nose frequency of non-nose whistlers has been extended and applied to both theoretical whistlers propagating in a model magnetosphere and groups of whistlers observed at Halley Bay, Antarctica where it is often difficult to identify the causative sferic. The accuracy of determination of the whistler parameters: nose frequency (f_n) and minimum group delay (t_n) is sufficient, in a period of high whistler activity, to determine the east-west electric field with a precision of about 0.1 mV/m in a 15-min period and the tube

electron content with an error normally less than 10 per cent. (auth)

31008 PARTICLE AND AURORAL OBSERVATIONS FROM THE ESRO I/AURORAE SATELLITE. Deehr, C. S. (Norske Institutt for Kosmisk Fysikk, Oslo); Egeland, A.; Aarsnes, K.; Amundsen, R.; Lindalen, H. R.; Soraas, F.; Dalziel, R.; Smith, P. A.; Thomas, G. R.; Stauning, P.; Borg, H.; Gustafsson, G.; Holmgren, L. A.; Riedler, W.; Raitt, J.; Skovli, G.; Wedde, T.; Jaeschke, R. J. Atmos. Terrest. Phys.; 35: No. 11, 1979-2011(Nov 1973).

The polar-orbiting satellite ESRO I/AURORAE (1968-084A) was designed to investigate auroral particles, luminosity, and associated ionospheric effects. Three groups of three consecutive passes over the auroral zone at three levels of magnetic activity were chosen for a special study. The passes occurred between midnight and 0100 hr geomagnetic time near the Scandinavian meridian. The latitude profile of the electron density at altitudes 300 to 400 km shows the ionospheric electron density trough (associated with the plasmapause) just equatorward of the main precipitation zone. The poleward wall of the trough is associated with a maximum in electron temperature. A broad maximum in electron density lies both poleward and equatorward of the high, structured gradients associated with the main precipitated zone. A depression in electron density approaching the pole is associated with an increase in electron temperature and a disappearance of O^+. The latitudinal profile of 4278 Å N_2^+ and 4861 Å Hβ emissions can, in all cases, be characterized as a single, broad maximum on the equatorward side inside the trapping boundary and one or more sharp maxima usually on the poleward side of the trapping boundary. The latitudinal width of the precipitation region is inversely proportional to the energy of the incoming particles. The isotropy of the distribution of electron intensity with pitch angle inside the trapping boundary decreases with energy and increases with intensity. The trapping boundary lies within the luminous aurora but equatorward of the bright arcs characteristic of the poleward boundary during the night. The incoming particle spectrum on the equatorward side is smooth and contains a small maximum which moves to greater energy with increase in latitude. On the poleward side, the higher energy electrons (>40 keV) decrease in intensity and the energy spectrum becomes disarranged with "monoenergetic" maxima appearing at energies <13 keV. (auth)

31009 INERTIAL MAGNETIC FIELD RECONNECTION AND MAGNETOSPHERIC SUBSTORMS. Van Hoven, G. (Department of Physics, University of California, Irvine, California, 92664); Cross, M.A. Phys. Rev. Lett. 30: No. 14, 642-644 (2 Apr 1973).

We describe and calculate the growth rate of a magnetohydrodynamic neutral-sheet instability due to electron-inertia terms in the infinite-conductivity Ohm's law. The results are compared with an approximate Vlasov-equation calculation, and are shown to be particularly germane to the geomagnetic-tail instability. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 30530, 30550, 30551, 31645, and 31740.

31010 (IPP-9/13) ABOUT THE MECHANISM OF SPUTTERING WITH LIGHT IONS IN THE keV-ENERGY REGION. Behrisch, R.; Sigmund, P.; Weissmann, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F.R. Germany)). Jun 1973. 37p. (In German). Dep. NTIS (U.S. Sales Only). $4.00.

Sputtering yields for 33 to 150 keV protons normally incident on Cu-films were determined by Rutherford backscattering. The Cu-films were deposited on different base materials (Be, V, Nb, Ta) which have different backscattering intensities. The measured sputtering yields are dependent on the nuclear charge Z of the base material, i.e. the backscattered ions from the interior of the base material contribute to sputtering. The contribution of the backscattered ions was calculated by the theory of Sigmund, which was extended for the case of light ions. The comparison of the theoretical sputtering yields with measurements of other authors shows better agreement of the energy dependence than former sputtering theories. A comparison with own measurements was only possible with reservation and yields for the relative contribution of the backscattered ions to sputtering greater deviations, which could not yet be completely explained. (auth)

31011 (IPP-9/14) MULTIPLE SCATTERING OF PROTONS AND HELIUM IONS IN POLYCRYSTALLINE METAL FOILS. Schaeffler, H. G. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F.R. Germany)). Jun 1973. 37p. (In German). Dep. NTIS (U.S. Sales Only) $4.00.

Multiple scattering of protons and helium ions with energies between 50 and 150 keV in nickel and niobium foils was investigated theoretically and experimentally. The angular and energy distributions were determined by Monte Carlo calculations. The results agree with the meanwhile published theory of Meyer within its range of validity if the mean energy of the particles in the foil as determined by the Monte Carlo calculation is used for comparison. In conjunction with electron microscopy the experiments showed a strong influence of single crystal effects (channeling) when crystallites with diameters larger than the foil thickness were present in the foils. This results in angular distributions that are too narrow. Foils whose crystallites are small relative to the foil thickness can be regarded as amorphous in terms of the theories of Molière or Meyer and the Monte Carlo calculations. The angular distributions measured for protons and helium ions in amorphous (polycrystalline) foils are generally broader than the theoretical distributions. From this deviation it is possible to determine experimentally the interaction potential since other causes can be ruled out. The experimental results relating to the half-width and the form of the angular distributions are described by the theory if the Thomas–Fermi potential used in the theory is retained and the screening radius is determined from the experiments. As postulated by the theory, the half-widths of the angular distributions are inversely proportional to the energy of the bombarding particles. Particles that emerge charged or neutral from the scattering foils have the same angular distributions. (auth)

31012 DOPPLER-BROADENED ANNIHILATION RADIATIONS IN SOME METALS. Sen, P. (Sunya, Albany, NY); Patro, A. P.; Rama Rao, M. Nuovo Cim.; 17B: No. 1, 212-218(11 Sep 1973).

The Doppler-broadened annihilation radiations from annihilation events in several metals were investigated using a high-resolution Ge(Li) detector with 1.87 keV (f.w.h.m.) for the ^{85}Sr nuclear gamma-ray. When metals are grouped according to the periodic table the plot of αX^2 vs. the Fermi energy gives a straight line as expected from the simple model of Alfano et al., including the IV A group metals. The width X appears to depend more on the momentum distribution than on the Fermi energy alone. From the observed systematics, estimates for the effective-mass ratio of the electron were made for Pb and B to be 0.03 and 3.45, respectively. (auth)

31013 SYNCHRONIZED STEP VOLTAGE SOURCE FOR ELECTRON ACCELERATION. Maeda, K.; (Electrotechnical Lab., Tokyo); Koyama, Y.; Suzuki, I. H.; Nagase, K. Shitsuryo Bunseki; 21: No. 2, 149-158(Jun 1973). (In Japanese).

In measuring the ionization efficiency curve by electron bombardment, mass analyzed ion counts have to be accumulated for successive values with a fixed interval of electron energy. For this purpose, a step voltage source for the electron acceleration was designed and constructed which can synchronize the advancing of memory channels in a pulse height analyzer. The synchronization and correspondence of the accelerating voltages to the PHA channels were kept by generating a series of logic pulses in a time sequence. The pulses were generated and controlled by using a network of about 30 digital IC's and 7 linear IC's. Performance tests have proved that the correspondence between the voltages and the channels is certainly kept and the combination of the voltage source and the PHA system does work well with good accuracy in wide ranges of step times (0.1 to 50 sec) and step voltages (0.01 to 0.5 eV). (auth)

31014 BEAM FRACTIONS IN THE LOWEST-QUARTET METASTABLE AUTOIONIZING STATE FOR O^{5+} AND F^{6+} BEAMS AFTER PASSAGE THROUGH FOILS. Smith, W.W. (University of Connecticut, Storrs, Connecticut 06268); Donnally, B.; Pegg, D.J.; Brown, M.; Sellin, I.A. Phys. Rev. A 7: No. 2, 487-491 (Feb 1973).

When fast beams of oxygen and fluorine ions are incident on carbon and metal foils thick enough to produce charge-state equilibrium, a significant portion of the lithiumlike beam fraction emerges in excited metastable autoionizing states. We have studied the yield of these states with beams in the range 2–20 MeV incident on nominal 10-$\mu g/cm^2$ carbon foils and on various metallic foils. The decay in flight of the lowest of these states, the $(1s2s2p)\ ^4P^o_{5/2}$, is monitored with observation of the spectrum of ejected electrons. We find, for example, that the maximum yield of this single state per incident beam particle is approximately 0.8% and 0.6% for oxygen and fluorine, respectively, on carbon. The energy dependences and target-material dependences are measured and discussed. Comparison is made to related work of Dmitriev et al. (auth)

31015 ION SOURCE WITH A LONG ANODE. Konstantinov, S. G.; Myskin, O. K.; Tsel'nik, F. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 378-380(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 38-40(1973).

The source is in the form of a Penning cell operating in a powerful (about 10 kOe) magnetic field at a gas pressure of 0.1 to 1 torr. The anode length exceeds the mean-free path of a gas molecule calculated according to the ionization cross section. This allows the values of the gas economy factor ~0.5 to be obtained for an output-aperture diameter equal to the anode diameter (5 mm). In order to extract a current of H_2 ions equal to 200 mA no extracting voltage is required. (auth)

31016 SIMPLE ION SOURCE FOR MANY PURPOSES. Boltz, C. L. Z. Wirt. Fertigung; 68: No. 4, 212-213(1973). (In German).

A new source for the production of positive ions is described which is both simple and cheap. It is suitable for the production of extremely thin samples in electron microscopy, for the cleaning of surfaces, for Auger and electron spectroscopy as well as for ion implantation and the coating of surfaces. (GE)

31017 PULSED PENNING ION SOURCE. Oka, Y.; Tamagawa, H. (Nagoya Univ., Japan). Shinku; 16: No. 6, 208-216(Jun 1973). (In Japanese).

An experiment on a pulsed cold cathode PIG ion source of modified Keller-type was investigated. The source was designed for a Cockcroft-Walton accelerator for a pulsed neutron generation. Ion current of 10 mA was extracted from deuterium discharge at the discharge pressure of 10^{-2} Torr for the discharge current of 0.5 A and the extraction voltage of 20 kV. The ion energy spectra were observed in detail, and it was observed that an energy spread was narrower than that which was observed by Nagy. The voltage to maintain the discharge rises day by day, but change in the energy spectra was small. This new designed ion source is convenient and more suitable for practical use. (auth)

31018 MEAN LIFE OF THE METASTABLE 2 $^3P_1$ STATE OF THE TWO-ELECTRON FLUORINE ION. Mowat, J.R.; Sellin, I.A.; Peterson, R.S.; Pegg, D.J. (The University of Tennessee, Knoxville, Tennessee 37916); Brown, M.D.; Macdonald, J.R. Phys. Rev. A 8: No. 1, 145-150 (July 1973).

By measuring the radiative decay in flight of a foil-excited heliumlike fluorine beam, we have determined the lifetime of the metastable 2 $^3P_1$ state of the two-electron ion F^{7+}. Our data yield the singlet triplet intercombination transition probability $A(1\ ^1S_0 - 2\ ^3P_1) = (1.77 \pm 0.10) \times 10^9\ sec^{-1}$, which is in excellent agreement with theoretical calculations of a strongly Z-dependent spin-orbit-induced electric dipole decay, and extends our earlier measurements for ions in this isoelectronic sequence. Because this transition is observed in the solar spectrum for all abundant heliumlike ions from carbon to iron, we also discuss the relevance of this measurement to solar physics. (auth)

31019 EXCITED-STATE ATOMIC-HYDROGEN POPULATION RESULTING FORM 10-KEV PROTON AND 20-KEV H_2^+ BEAMS COLLIDING WITH A MAGNESIUM VAPOR TARGET. Stewart, L.D.; Forsen, H.K. (Department of Nuclear Engineering, The University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. A 8: No. 1, 184-190 (July 1973).

Investigations are made of the production of excited-state hydrogen neutrals using 10-keV proton or 20-keV H_2^+ beams and a magnesium vapor cell. Optical measurements are used to determine the population of the $n = 6$ level as a function of target thickness and to determine the relative populations for $3 \leq n \leq 8$. The cross section for capture into the $n = 6$ level for incident H_2^+ is found to be about equal to that for incident protons. An approximate $1/n^3$ dependence of the excited-state populations is found for $n \geq 6$ with an assumed $2l + 1$ weighted substate distribution. (auth)

31020 DESORPTION OF SOLID HYDROGEN BY ENERGETIC PROTONS, DEUTERONS, AND ELECTRONS. Erents, S.K.; McCracken, G.M. (UKAEA Research Group, Culham Laboratory, Abingdon, Berks, England). J. Appl. Phys. 44: No. 7, 3139-3145 (July 1973).

The yield of condensed gas released from liquid-helium-cooled surfaces under particle bombardment has been measured as a function of surface coverage. The yield has been found to increase at low coverage, then become roughly independent of coverage, and finally to decrease at very high coverage. The observed value of the yield has been found to exceed 10^4 atoms/ion and this value has been explained in terms of a thermal spike model. Where the condensed layer thickness is greater than the range of the incident ions the yield is typically 10^2–10^3 atoms/ion. This cannot be explained either by thermal spike or conventional sputtering, and it is suggested that ionization of the condensed gas leads to gas release. (auth)

Atomic and Molecular Properties

Refer also to abstracts 30628, 31018, and 31121.

31021 SECOND-ORDER CORRECTIONS TO THE FINE STRUCTURE OF HELIUM. III. IMPROVED CALCULATION OF SOME ^3P CONTRIBUTIONS. Hambro, L. (Department of Physics, University of California, San Diego, La Jolla, California 92037). Phys. Rev. A 7: No. 2, 479-486 (Feb 1973).

Spin-dependent perturbations from intermediate ^3P states are calculated by expanding the perturbations to the wave function in terms with one negative power of one of the electron or interelectron coordinates, in addition to standard Hylleraas terms. the nonstandard terms reflect singularities of the Breit operators. A method for solving linear equations with "almost-singular" coefficient matrices is devised. Significant improvement in accuracy is achieved for five contributions, but the procedure does not work well in all cases where the coefficient matrix is unsymmetrical. (auth)

31022 DETERMINATION OF THE RYDBERG CONSTANT FROM THE He II n = 3-4 (469-NM) LINE COMPLEX. Kessler, E.G. Jr. (Institute for Basic Standards, National Bureau of Standards, Washington, D. C. 20234). Phys. Rev. A 7: No. 2, 408-415 (Feb 1973).

The Rydberg constant has been determined from absolute wavelength measurements on two fine-structure components of the He II n = 3-4 transition. The He II transition was excited in a liquid-nitrogen-cooled hollow cathode. A pressure-scanned Fabry-Perot spectrometer was used to compare the He II wavelengths with a ^{198}Hg standard source. The measured value of the Rydberg is $R^\infty = 109737.3208 \pm 0.0085\ cm^{-1}$, where the uncertainty is one standard deviation. (auth)

31023 QUADRUPOLE MOMENTS OF Dy^{163} AND Dy^{161}. Murakawa, K. (Tokyo-Denki College, Kanda-Nishikicho, Chiyoda-Ku, Tokyo, Japan). Phys. Rev. A 7: No. 2, 416-417 (Feb 1973).

The hyperfine structure of the spectrum of Dy I was studied by means of a Fabry-Perot etalon. The dipole- and quadrupole-coupling constants of the levels $4f^{10}(^5I_{7,8})6s6p(^3P_{2,1})$ with J=9 were deduced; these levels were found to be free from configuration mixing. From the quadrupole-coupling constant of the level $[4f^{10}(^5I_7)6s6p(^3P_2)]_9$ the contribution of the 6p electron alone was separated, from which it was deduced that $Q^{163} = +2.46(21)b$ and $Q^{161} = +2.33(20)b$, the Sternheimer correction being taken into account. (auth)

31024 DIRECT-RESOLVENT-OPERATOR COMPUTATIONS ON THE HYDROGEN-MOLECULE DYNAMIC POLARIZABILITY, RAYLEIGH, AND RAMAN SCATTERING. Ford, A.L. (Department of Chemistry, The University of Texas, Austin, Texas 78712); Browne, J.C. Phys. Rev. A 7: No. 2, 418-426 (Feb 1973).

Direct sum-over-states methods are used to evaluate the frequency-dependent polarizability and anisotropy for ground-state H_2. Rayleigh and rotational and vibrational Raman cross sections for photon scattering and depolarization ratios are given for Lyman-α radiation. An assessment of the accuracy obtainable by the direct use of sum-over-states methods indicates its high promise as a technique for accurate computation of molecular properties. The Dalgarno-Epstein [J. Chem. Phys. 50, 2837 (1969)] techniques for obtaining a finite-set representation of components of the resolvent operator is shown to be effective for molecules. (auth)

31025 MULTIPOLE EXPANSION OF THE RETARDED INTERATOMIC POTENTIAL ENERGY. VI. Dispersion and Induction Energy for Relativistic Hydrogen Atoms. Michels, M. A. J.; Suttorp, L. G. (Univ., Amsterdam). Physica; 67: No. 1, 137-165 (1 Jul 1973).

The inductive and dispersive retarded interaction energies of two ground-state hydrogen atoms described by Dirac theory are derived up to all multipole orders. The results are obtained by evaluation of Feynman diagrams and with the help of dispersion-relation methods. The nonrelativistic and semi-relativistic approximations of the interaction energy are given in a form that shows explicitly the contributions of electron spin. (auth)

31026 HYDROGENIC WAVEFUNCTIONS AND PERTURBATION THEORY. Killingbeck, J. (Hull Univ., Eng.). Mol. Phys.; 26: No. 2, 391-396(Aug 1973).

The use of hydrogenic orbitals in atomic calculations is discussed, and values are given for the nontraditional $F^{(k)}$ (Slater) and $M^{(k)}$ integrals needed in variational calculations. The method used for their derivation is also applied to derive two other integrals, which are used to give a generalization of previous first-order perturbation calculations of $\langle r_1^n + r_2^n \rangle$ for the $1s^2$ state of two-electron ions. (auth)

31027 VARIATIONAL CALCULATION ON THE POSSIBLE EXISTENCE OF A BOUND STATE OF He_3. Bosanac, S.; Murrell, J. N. (Univ. of Sussex, Eng.). Mol. Phys.; 26: No. 2, 349-359 (Aug 1973).

A variational calculation has confirmed earlier suggestions that $^4He_3$ has a bound state. The partial wave expansion of Simonov was found to be slowly convergent and by this method no bound state was obtained although there was clear evidence that He_3 would be closer to a stable bound state than He_2. A variational wave function based directly on interparticle separations and the use of Morse-potential eigenfunctions was rapidly convergent and gave a lower limit to the binding energy of 0.63 K. (auth)

31028 AB INITIO CALCULATION OF THE $He_2 X^1\Sigma_g^+ \rightarrow A^1\Sigma_u^+$ ABSORPTION SPECTRUM. Mukamel, S.; Kaldor, U. (Tel Aviv Univ., Israel). Mol. Phys.; 26: No. 2, 291-295(Aug 1973).

The absorption spectrum of helium gas near 600 Å, assigned to the $A^1\Sigma_u^+ \leftarrow X^1\Sigma_g^+$ transition in He_2, is calculated at 77°K. The excited state potential is taken from a recent ab initio calculation (Mukamel et al., Molec. Phys.; 22: 1107 (1971)). The theoretical spectrum shows well defined bands, corresponding to different vibration levels of the A state, with diffuse rotational structure, in agreement with experiment. Fairly good quantitative agreement with Tanaka and Yoshino's (J. Chem. Phys.; 50: 3087 (1969)) measured spectrum is obtained, except for the somewhat too large separation between calculated vibrational bands, probably due to the theoretical potential for the A state rising too steeply at small internuclear separation. Rotational constants derived from the calculated and experimental spectra are in good agreement. It is shown that they are significantly smaller than actual rotational constants of the upper state. (auth)

31029 ITERATIVE PERTURBATION CALCULATIONS OF GROUND AND EXCITED STATE ENERGIES FROM MULTICONFIGURATIONAL ZEROTH-ORDER WAVEFUNCTIONS. Huron, B. (Observatoire de Meudon, France); Malrieu, J. P.; Rancurel, P. J. Chem. Phys.; 58: No. 12, 5745-5759(15 Jun 1973).

A method is proposed to calculate the effect of configuration interaction by a Rayleigh–Schroedinger perturbation expansion when starting from a multiconfigurational wave function. It is shown that a careless choice of H_0 may lead to absurd transition energies between two states, at the first orders of the perturbation, even when the perturbation converges for both states. A barycentric definition of H_0 is proposed, which ensures the cancellation of common diagrams in the calculated transition energies. A practical iterative procedure is defined which allows a progressive improvement of the unperturbed wave function ψ^0; the CI matrix restricted to a subspace S of strongly interacting determinants is diagonalized. The desired eigenvector ψ^0 of this matrix is perturbed by the determinants which do not belong to S. The most important determinants in ψ^1 are added to S, etc. The energy thus obtained after the second-order correction is compared with the ordinary perturbation series where ψ^0 is a single determinant. For the ground state, this procedure includes, besides the whole second-order

correction, the most important terms of the third and fourth orders. The question of orthogonality of excited states is discussed. This technique, hereafter called CIPSI, was tested on the ground and several excited states of H_2, NaH, and MgO, showing both a rapid convergence of the calculated transition energy and the importance of correlation effects on transition energy. (auth)

31030 BALMER-LINE ANOMALIES IN A TURBULENT PLASMA. Gallagher, C.C.; Levine, M.A. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts). Phys. Rev. Lett. 30: No. 19, 897-900 (7 May 1973).

Resonance effects between orthogonal components of dynamic and quasistatic electric fields within a turbulent hydrogen plasma are shown to produce satellites on the H_β profile. The splitting on H_α, H_β, H_γ, and H_δ profiles indicates that the quasistatic field strength is 0.9×10^7 V/m. By using a helium tracer, comparison of a forbidden transition with its satellites indicates that the dynamic field (at the plasma frequency) is 1.3×10^7 V/m. (auth)

31031 PHOTON-SCATTERING THEORY OF THE QUENCHING OF HYDROGENIC METASTABLES. Drake, G.W.F.; Grimley, R.B. (Department of Physics, University of Windsor, Windsor, Ontario, Canada). Phys. Rev. A 8: No. 1, 157-160 (July 1973).

The quenching of hydrogenic metastables is formulated as a near-resonant photon-scattering problem, and a complete analysis of the polarization and angular distribution of the emitted radiation is presented. The contribution from np states with $n>2$ is calculated, and an alternative method of measuring the Lamb shift is suggested. (auth)

31032 ELECTRON SPECTRA FROM COLLISIONS OF O^- AND O WITH HELIUM. Edward, A.K.; Cunningham, D. L. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). Phys. Rev. A 8: No. 1, 168-173 (July 1973).

Three new autodetaching states of O^- have been found and an electron configuration has been assigned one of two previously observed transitions. This gives a total of five known autodetaching states of O^-. Transitions from these states appear as peaks in the spectrum of electrons produced in collisions of O^- ions with a helium target. These peaks lie at 9.50, 10.11, 10.87, 12.12, and 13.71 ± 0.02 eV. The electron spectrum produced by collisions of neutral O with helium shows four autoionizing series of oxygen lying just above the first ionization potential. (auth)

31033 PHOTON-PARTICLE COINCIDENCE MEASUREMENT OF CHARGE-TRANSFER EXCITATION OF THE N_2^+ FIRST NEGATIVE 3914-Å BAND BY PROTONS. Wehrenberg, P.J.; Clark, K.C. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. A 8: No. 1, 173-179 (July 1973).

The cross section for charge-transfer excitation of N_2^+ first negative 3914-Å band by protons (5-65 keV) has been measured using a photon-particle coincidence technique. The target N_2 is collisionally excited to the N_2^+ ($B\ ^2\Sigma_u^+$) state and emits a 3914-Å photon in the (0,0) transition. This photon is detected in coincidence with the scattered particle, a proton or hydrogen atom, allowing separation of the two reactions which contribute to 3914-Å emission. The cross section for charge-transfer excitation indicates that charge transfer is the dominant contributor to 3914-Å excitation at energies below 10 keV, and that ionization with excitation becomes increasingly important with increasing energy. The by-product measurements, which include the cross section for charge transfer, the total cross section for 3914-Å emission, and the lifetime of the N_2^+ ($B\ ^2\Sigma_u^+$) state, agree well with those of other workers. (auth)

31034 EXTENDED DIATOMICS IN MOLECULES CALCULATIONS. Steiner, E.; Certain, P.R.; Kuntz, P.J. (Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 59: No. 1, 47-55 (1 July 1973).

The diatomics in molecules method of estimating polyatomic energy surfaces is extended to include valence bond configuration interaction. The results are applied to H_3, using a basis of covalent and ionic functions. The method is found to be stable to the addition of the ionic functions, but it is found to be necessary to assume that the overlap between orbitals centered on different atoms vanishes. (auth)

31035 X-RAY SPECTRA OF SUPERHEAVY AND QUASI-SUPERHEAVY ELEMENTS. Fricke, B.; Waber, J.T. (Department of Materials Science, Northwestern University, Evanston, Illinois 60201). Phys. Rev. C 8: No. 1, 330-335 (July 1973).

We discuss the possibility of identifying superheavy elements from the observation of their M-shell x-ray spectra, which might occur during the collision of a superheavy element with a heavy target. The same question is discussed for the possible observation of the x-rays from the quasimolecule (quasi-superheavy element) which is formed during such a heavy-ion collision. It is shown that it is very difficult, if not impossible, to determine any information about the interesting quantum electrodynamical effects from the M-shell x-ray spectra of these quasimolecules. (auth)

31036 CALCULATIONS AND ESTIMATES OF THE GROUND-STATE ENERGY OF HELIUM TRIMERS. Bruch, L.W. (Theoretical Chemistry Institute and Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); McGee, I.J. J. Chem. Phys. 59: No. 1, 409-413 (1 July 1973).

Variational calculations of the ground state energy of ^{4}He trimers are reported and are compared with the Hall-Post-Stenschke lower bound on the ground state energy. The variational result for the ground state energy for a range of model pair potentials is in the range -0.05—0.2 K; the effect of the triplet nonadditive term is estimated to be less than 1% of the contribution of the pair potentials. A study of the variation of the ground state energy of 3 bosons with pair potential coupling constant is also reported for a Lennard-Jones and a Morse potential model. There is no bound spin 3/2 ^{3}He trimer; a lower bound is given for the ground state energy of the spin 1/2 trimer and analogy with the boson results is used to argue that the spin 1/2 trimer is probably not bound. This paper contains computational applications of formal results derived elsewhere. (auth)

31037 SYMMETRY OF A HYDROGEN ATOM IN A WEAK MAGNETIC FIELD. Yanagawa, S. (Department of Applied Physics, University of Tokyo, Tokyo, Japan). Phys. Rev. A 8: No. 1, 46-48 (July 1973).

The degeneracy problem of a hydrogen atom in a uniform weak magnetic field H is considered from the standpoint of the invariance group that the system obeys. Evidently the degeneracy space has a constant z component of the angular momentum. Under such a classification, the dynamical invariance of the problem is shown to be an isomorph to the Lie group of the linear transformation of the straight line. (auth)

31038 CALCULATION OF THE ^{1}P(2s2p) AUTOIONIZATION STATE OF He WITH A PSEUDOSTATE NONRESONANT CONTINUUM. Bhatia, A.K. (Laboratory for Space Physics, Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, Maryland 20771); Burke, P.G.; Temkin, A. Phys. Rev. A 8: No. 1, 21-26 (July 1973).

Previous Hylleraas calculations of $E = \langle QHQ \rangle$ for the lowest ^{1}P autoionization state of helium are here supplemented by calculations of the shift (Δ), width (Γ), and shape parameter (q) using a (ls, $\bar{2}$p), pseudostate nonresonant continuum function. The function is constructed to eliminate the dominant (2s, 2p) configuration of the autoionization state, while at the same time containing three variationally determined radial functions. Both Δ and q are also shown to contain contributions from the discrete part of the nonresonant spectrum, although quantitatively that contribution is found to be small. Final results change previous polarized-orbital results minimally, which means that the resonance position, $E = E + \Delta$, continues to be on the edge of the experimental error, and q remains somewhat outside the experimental result. Further relativistic corrections are briefly discussed, but a simple argument indicates that they are not likely to explain the differences with experiment. It is concluded that more-accurate experiments should be carried out. (auth)

31039 STARK BEATS IN LYMAN-SERIES EMISSION. Alguard, M.J.; Drake, C.W. (Department of Physics, Oregon State University, Corvallis, Oregon 97331). Phys. Rev. A 8: No. 1, 27-36 (July 1973).

Observed intensity fluctuations in the emission of Stark-perturbed Ly-β radiation, from hydrogen atoms formed by passage of hydrogen ions through carbon foils, are compared with theoretical calculations using a density-matrix formalism to yield information on the cross sections for creation into the various l states. It is found, for beam energies between 250 and 500 keV/atom, that the s states are preferentially populated by more than a factor of 4, compared to a statistical distribution. Similar results are also obtained for Ly-α emission in electric and motional electric fields, in contrast with previous reports at lower energies. The effects of Zeeman splittings, hyperfine interaction, and fringing fields on the signal are investigated. (auth)

31040 IONIZATION ENERGIES OF THE NEUTRAL ACTINIDES. Sugar, J. (National Bureau of Standards, Washington, D.C. 20234). J. Chem. Phys. 59: No. 2, 788-791 (15 July 1973).

Values for the ionization energies of the neutral actinides have been derived by utilizing interpolated spectral properties of these atoms. The results in electron volts are Ac: 5.17(12); Th: 6.08(12); Pa: 5.89(12); U: 6.05(7); Np: 6.20(12); Pu: 6.06(2); Am: 5.993(10); Cm: 6.09(2); Bk: 6.30(9); Cf: 6.41(10); Es: 6.52(10); Fm: 6.64(11); Md: 6.74(12); No: 6.84(12). (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 31063 and 31067.

31041 COMBINED ZEEMAN AND MOTIONAL STARK EFFECTS IN THE FIRST EXCITED STATE OF POSITRONIUM. Curry, S.M. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. A 7: No. 2, 447-450 (Feb 1973).

Calculations are presented of the combined Zeeman- and Stark-effect level shifts in the n=2 excited states of positronium, for positronium moving perpendicular to an applied magnetic field. Lifetimes of the Zeeman- and Stark-mixed n=2 states are also calculated. The electric field results from the Lorentz transformation of the magnetic field to the rest frame of the positronium and is perpendicular to the magnetic field. The level shifts and lifetimes are calculated by diagonalizing the 16×16 Hamiltonian matrix for positronium in crossed electric and magnetic fields. The unperturbed energy eigenvalues calculated by Fulton and Martin are used as the diagonal elements of the Hamiltonian. (auth)

31042 COMMENT ON THE GROUND STATE OF POSITRONIUM HYDRIDE. Houston, S.K. (Department of Applied Mathematics and Computing Science, University of Sheffield, Sheffield S10 2TN, England); Drachman, R.J. Phys. Rev. A 7: No. 2, 819-820 (Feb 1973).

A new, more accurate calculation of the ground-state wave function of positronium hydride has been carried out. The method is variational and is similar to that reported by Lebeda and Schrader. The "molecule" is found to be stable against separation into positronium and hydrogen by at least 0.672 eV, an increase of 2% above the best previous value. The mean lifetime against two-photon annihilation is 0.407 nsec, as obtained from the energy-minimizing wave function. The "cusp value" of -0.477 is close to the exact value, -1/2, giving an indication of the quality of the trial function. (auth)

31043 PHOTOMAGNETIC POSITRONIUM-SPIN CONVERSION IN SOLIDS. Brandt, W.; Kliauga, P. (Department of Physics, New York University, New York, New York, 10003). Phys. Rev. Lett. 30: No. 9, 354-357 (26 Feb 1973).

We have observed spin conversion of orthopositronium and parapositronium in interaction with photoexcited, metastable, paramagnetic triplet states of phosphorescent molecules in rigid solutions, through changes in the positron lifetime spectra induced by light. The results bear on the statistics of the spin conversion processes, and on the diffusion of positronium in solids. (auth)

31044 FOURTH-ORDER VACUUM POLARIZATION CORRECTION TO THE POSITRONIUM HYPERFINE STRUCTURE. Owen, D.A. (Centre de Physique Théorique, Centre National de la Recherche Scientifique, Marseille, France). Phys. Rev. Lett. 30: No. 19, 887-888 (7 May 1973).

It is shown that the fourth-order vacuum polarization correction to the annihilation diagram contributes $\Delta\nu = -(1/4)\ \alpha^4 R_\infty \ln\alpha^{-1}$ to the positronium ground-state hyperfine structure. This leads to a reduction of 11.3 MHz in the previous theoretical prediction which greatly improves the agreement between theory and experiment. (auth)

31045 MECHANISM FOR μ^+ DEPOLARIZATION IN LIQUIDS —MUONIUM CHEMISTRY WITH RADICAL FORMATION. Brewer, J.H.; Gygax, F.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Fleming, D.G. Phys. Rev. A 8: No. 1, 77-86 (July 1973).

The phenomenon of environment-dependent "fast" depolarization of stopped positive muons is described in terms of a theoretical model. The formalism is similar to that developed by Ivanter and Smilga to describe the "proper muonium mechanism," but has been adapted and expanded to include situations involving more than one strongly depolarizing influence (i.e., muonium and a molecular radical). For a plausible situation in dilute solutions with transverse applied magnetic field, the exact time dependence of the muon polarization is derived formally, with the "residual polarization" emerging as a limit. The result can be applied to the study of muonium chemistry. (auth)

31046 MUONIUM. IV. PRECISION MEASUREMENT OF THE MUONIUM HYPERFINE-STRUCTURE INTERVAL AT WEAK AND VERY WEAK MAGNETIC FIELDS. Thompson, P.A.; Crane, P.; Crane, T.; Amato, J.J.; Hughes, V.W.; zu Putlitz, G.; Rothberg, J.E. (Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 8: No. 1, 86-111 (July 1973).

A complete discussion is given of our precision measurement of the hyperfine-structure interval $\Delta\nu$ of the ground state of muonium at a weak magnetic field ($\approx$ 3 G) using the resolved transitions $(F, M_F) = (1, \pm 1) \rightarrow (0, 0)$, and at a very weak magnetic field ($\approx$ 10 mG) using unresolved transitions $\Delta F = \pm 1$. The method of magnetic resonance studies of muonium is used, where a single oscillatory field is employed and the resonance line is swept by varying the applied frequency. This research yielded values for the coefficients of the linear hfs density shifts for muonium in argon and krypton at a temperature of approximately 20 °C: $a_{M\text{-}Ar} = -5.00(22) \times 10^{-9}$/Torr, $a_{M\text{-}Kr} = -10.57(39) \times 10^{-9}$/Torr, and also for the quadratic hfs pressure-shift coefficients: $b_{M\text{-}Ar} = 8.1(2.5) \times 10^{-15}$/(Torr)^2. $b_{M\text{-}Kr} = 8.6(5.9) \times 10^{-15}$/(Torr)^2 The value obtained for $\Delta\nu$ is $\Delta\nu = 4463.308(11)$ MHz (2.5 ppm), where the 1-standard-deviation error is principally a statistical counting error. Our result for $\Delta\nu$ is in good agreement with other measurements of $\Delta\nu$ and also with the current theoretical value. (auth)

31047 NUCLEAR POLARIZATION AND THE MUONIC X-RAY SPECTRUM OF Pb. Shakin, C.M. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106); Weiss, M.S. Phys. Rev. C 8: No. 1, 411-413 (July 1973).

The importance of nuclear core excitation for the muonic x-ray spectrum of lead is emphasized. The consideration of octupole nuclear polarization is shown to affect the position of the 3d levels in muonic ^{208}Pb. Inclusion of the nuclear polarization effects may aid in the explanation of an anomaly found by Ford and Rinker in their analysis of muonic transitions in the lead isotopes, as level shifts due to core polarization are of the order of the discrepancies between theory and experiment. (auth)

Collision Phenomena

Refer also to abstracts 29655–29657, 29992, 31019, 31032, 31033, 31121, 31670, and 31679.

31048 (CONF-730301-P1, pp 247-248) COHERENT BREMSSTRAHLUNG PRODUCED BY RELATIVISTIC POSITRONS AND ELECTRONS ON A SINGLE CRYSTAL OF SILICON. Walker, R. L.; Berman, B. L.; Bloom, S. D. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The spectral dependence of the forward coherent bremsstrahlung produced by a beam of 28-MeV positrons or electrons incident on a 5-μm-thick single crystal of silicon was measured with a 12.5 × 15-cm NaI photon spectrometer. The results for the incident electron beam are shown. The results for the positron case are similar, except for the bremsstrahlung suppression when the positron beam was highly channeled. (auth)

31049 (CONF-730301-P1, pp 249-251) ANOMALOUS ELECTRON STRAGGLING THROUGH THIN SINGLE CRYSTALS. Tomimasu, T.; Mikado, T.; Yamazaki, T. (Electrotechnical Lab., Tokyo). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Anomalous broadenings in straggling distributions of 24.8-MeV electrons are found along the Si(100) axial direction, and incident angular dependence of these anomalies is studied around the axis. An additional broadening reaches to 8.5% along the axis of 0.2067 g/cm^2 Si. (auth)

31050 (CONF-730301-P1, pp 257-258) MEASUREMENT OF BREMSSTRAHLUNG SPECTRA PRODUCED IN IRON, TUNGSTEN, AND LEAD TARGETS BY 15- AND 20-MeV ELECTRONS WITH ACTIVATION DETECTORS. Nakamura, T.; Hirayama, H. (Kyoto Univ.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Bremsstrahlung spectra from tungsten and iron targets bombarded by high-energy electrons were measured using threshold detectors. (LTW)

31051 OBSERVATION OF A K X-RAY BAND EMITTED BY THE TRANSIENT C–C SYSTEM FORMED AT keV energies. Macdonald, J.R.; Brown, M.D.; Chiao, T. (Department of Physics and Nuclear Science Laboratory, Kansas State University, Manhattan, Kansas, 66506). Phys. Rev. Lett. 30: No. 11, 471-474 (12 Mar 1973).

The yield and high-energy limit (from 1.1 to 1.5 keV) of a K x-ray band emitted by the transient C–C collision system are reported for 19- to 240-keV carbon ions incident on graphite. This K x-ray band is interpreted as characteristic of the C–C system when the nuclear separation approaches the united-atom limit. A small yield of a similar band produced by other light ions in graphite has been observed; this can be accounted for in part by integrating the C–C yield over the appropriate energy distribution of recoil carbon atoms. (auth)

31052 ENERGY AND ANGULAR CORRELATIONS OF THE SCATTERED AND EJECTED ELECTRONS IN THE ELECTRON-IMPACT IONIZATION OF ARGON. Weigold, E.; Hood, S.T.; Teubner, P.J.O. (School of Physical Sciences, The Flinders University of South Australia, Bedford Park, South Australia 5042, Australia). Phys. Rev. Lett. 30: No. 11, 475-478 (12 Mar 1973).

Momentum distributions have been measured separately for 3p and 3s electrons in argon. The measured summed energy spectrum shows the presence of a peak which is analyzed in terms of electron–electron correlations. (auth)

31053 IMPACT-PARAMETER DEPENDENCE OF K-SHELL COULOMB-IONIZATION CROSS SECTIONS. Brandt, W.; Jones, K.W.; Kraner, H.W. (Brookhaven National Laborarory, Upton, New York, 11973). Phys. Rev. Lett. 30: No. 9, 351-354 (26 Feb 1973).

Coincidence measurements are reported between the characteristic K-shell x rays emerging from a target and the protons of energy 0.3–3 MeV, scattered by 5° from an incident beam, that cause the primary K-shell ionization. Absolute impact-parameter-dependent differential K-shell ionization cross sections are deduced for Al, Ca, Ni, and Ag. In a reduced plot the data follow a common curve that coincides with the semiclassical prediction of Bang and Hansteen. (auth)

31054 DYNAMIC SCREENING OF PROJECTILE CHARGES IN SOLIDS MEASURED BY TARGET X-RAY EMISSION. Brandt, W.; Laubert, R.; Mourino, M. (Department of Physics, New York University, New York, New York, 10003); Schwarzschild, A. Phys. Rev. Lett. 30: No. 9, 358-361 (26 Feb 1973).

We report a strong dependence of the Al K x-ray cross section in solid Al targets, for thicknesses ranging from 0.5 to 25 $\mu g/cm^2$, on the charge state of the incident oxygen projectiles, in the energy range 12–68 MeV. The results are analyzed in terms of the dynamic screening of the projectile charge by the electrons in the dense target, yielding a dynamic screening rate $\lambda = 5.5 \times 10^{14}$ sec^{-1} which is consistent with this approach. (auth)

31055 PROTON-IMPACT DISSOCIATION AND IONIZATION OF H_2^+ MOLECULAR IONS. Tripathi, A.N.; Mathur, K.C.; Joshi, S.K. (Physics Department, University of Roorkee, Roorkee, India). Phys. Rev. A 7: No. 2, 586-588 (Feb 1973).

Proton-impact ionization and dissociation of of the H_2^+ molecule is studied within the framework of the classical binary-encounter approximation. The effect of the Coulomb field of the ion is considered. A quantal momentum distribution is used for the bound electron. The R dependence of the cross section has been studied and an average cross section for two initial vibrational states ($\nu = 0$ and 3) is obtained. It is observed that the initial vibrational state has a marked influence on the total cross section. (auth)

31056 DISTORTED-WAVE CALCULATION OF ELECTRON-IMPACT EXCITATION OF ATOMIC OXYGEN. Sawada, T.; Ganas, P.S. (University of Florida, Gainesville, Florida 32601). Phys. Rev. A 7: No. 2, 617-626 (Feb 1973).

A distorted-wave formulation with exchange is given for the electron-impact excitation of atoms from $(n_0l_0)^N$ to $(n_0l_0)^{N-1}nl$ configurations using the LS-coupling scheme. Phenomenologically determined independent-particle models and distorted-wave potentials are utilized to compute angular distributions and integrated cross sections for 2p→3s, 3p, and 4p excitations of atomic oxygen over wide ranges of energy and momentum transfer. The results are compared with the Born-approximation limit as well as the experimental integrated cross section of Stone and Zipf. (auth)

31057 IMPACT-PARAMETER THEORY DEFINED AS A CONSTANT-COLLISION-VELOCITY SEMICLASSICAL LIMIT OF A COMPLETE QUANTUM-SCATTERING PICTURE. Riley, M.E. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. A 7: No. 2, 626-634 (Feb 1973).

A semiclassical limit, defined in terms of large mass and energy at fixed arbitrary collision velocity, is shown to be a simple formal prescription for obtaining a quantum treatment of the impact-parameter method and the eikonal approximation. In particular, for atom–atom collisions, the resultant approximation is emphasized to be a proper strong-coupling equation for inelastic processes, as opposed to the adiabatic result of a large-mass limit at fixed energy. (auth)

31058 AUTOIONIZATION OF He AND AUTODETACHMENT OF He^- FOLLOWING BOMBARDMENT BY H^+, H_2^+, He^+, AND He ATOMS. Schowengerdt, F.D.; Smart, S.R.; Rudd, M.E. (Behlen Laboratory of Physics, The University of Nebraska, Lincoln, Nebraska 68508). Phys. Rev. A 7: No. 2, 560-566 (Feb 1973).

Presented here are experimental results of a study of the systematics of electron emission from discrete states of He and He^- as produced by H^+, H_2^+, He^+, and He impacts. The results were obtained by energy analysis of the electrons emitted at angles of 10° to 160°. Projectile energies ranged from 20 to 150 keV. Differential and integrated cross sections are presented for emission of electrons from the 2s $^2(^1S)$, 2s2p(^3P), the sum of the 2p $^2(^1D)$ and 2s2p(^1P) autoionizing levels of He, and the 1s2s $^2(^2S)$ autodetaching levels of He^-. The 2s $^2(^1S)$ cross section is nearly isotropic, while the 2s2p(^3P) and 2p $^2(^1D)$ + 2s2p(^1P) cross sections are in general anisotropic. The ratios of the ^3P to the ^1S cross sections follow an approximate $A + B\cos^2\Theta$ form. The peak arising from the He^- level has an asymmetric profile with a positive q value which increases as the projectile energy decreases. (auth)

31059 VIBRATIONAL EXCITATION OF CO FRAGMENTS IN DISSOCIATIVE ATTACHMENT IN CO_2. Stamatovic, A.; Schulz, G.J. (Department of Engineering and Applied Science, Mason Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 7: No. 2, 589-592 (Feb 1973).

The dissociative attachment cross section for O^- from CO_2 in the neighborhood of 4.4 eV is examined with high resolution, and structure in this cross section is observed. We interpret this structure as an indication that vibrationally excited states of CO are produced in the reaction $e+CO_2 \rightarrow O^- + CO$. The magnitude of the cross section for the production of CO for individual states ($v = 0$–3) is estimated. The peak magnitudes of the dissociative attachment cross sections for production of CO in the vibrational states $v = 0$, 1, 2, and 3 are in the ratio of approximately 1:0.63:0.40:0.10. The threshold region for the dissociative attachment cross section in CO_2 is examined in the temperature range (200–300) °K, and it is found that this region can be described by a nonvertical onset and by the contribution of the bending mode to the attachment process. (auth)

31060 ASSOCIATIVE DETACHMENT OF O^- WITH CO, H_2, AND O_2. Mauer, J.L.; Schulz, G.J. (Mason Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 7: No. 2, 593-605 (Feb 1973).

The associative detachment reactions of O^- with CO, H_2, and O_2 are studied experimentally using an ion beam (0–10 eV) impinging on a gas-filled chamber. The resultant electrons are energy analyzed using retarding potentials. At low ion energy, cross sections for total electron detachment for the reactions of O^- with CO and H_2 vary as the inverse of the relative velocity. At higher energies, the cross sections show a broad peak. We interpret this shape in terms of the potential-energy curves of the compound states. The energy distributions for the electrons resulting from the reactions of O^- with CO and H_2 exhibit peaks at low energy corresponding to the excitation of high vibrational and rotational states of the resultant triatomic molecules (CO_2,H_2O). Progressions observed in these distributions have spacings corresponding to the preferential excitation of the bending modes of the triatomic molecules. The cross section for total electron detachment for the reaction of O^- with O_2 exhibits a threshold near 0.7 eV and rises linearly at higher energy. (auth)

31061 UNIFORM WKB THEORY OF INELASTIC COLLISIONS: APPLICATION TO $He^+ - Ne$ INELASTIC COLLISIONS. Eu, B.C.; Tsien, T.P. (Department of Chemistry, McGill University, Montreal, Canada). Phys. Rev. A 7: No. 2, 648-657 (Feb 1973).

The uniform WKB theory of inelastic collisions is discussed further and applied to a semiclassical analysis of the He^+–Ne inelastic collisions [$He^+ + Ne(2p^6) \rightarrow He^+ + Ne^*(2p^53s)$] at E = 70.9 eV. The uniform WKB differential cross section of the inelastic scattering is compared with that of the Landau–Zener–Stückelberg theory of inelastic collisions. The result of comparisons indicates that the uniform WKB theory is more reliable than the Landau–Zener–Stükelberg theory and the distorted-wave-Born-approximation theory. (auth)

31062 VARIATIONAL TECHNIQUE FOR SCATTERING THEORY. Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540); Conn, R. Phys. Rev. A 7: No. 2, 577-585 (Feb 1973).

A stationary variational functional for the T matrix that uses trial T matrices rather than trial wave functions is discussed. Taking a trial T matrix expressed as a general linear combination of matrices leads to a Fredholm integral equation of the first kind for the coefficient vector. The special case of a trial function having the same form as the Born series, except with variable coefficients, is treated in detail. Requiring the functional to be stationary with this trial form leads to the previously established result of Padé approximants to the scattering amplitude. Approximate techniques are used to evaluate the high-order Born integrals, and the behavior of the Padé approximants and the Born series is investigated for a Yukawa potential. An upper bound on the series is used to estimate its radius of convergence as a function of energy and potential strength. The variational calculations converge rapidly even for cases where the Born series diverges. (auth)

31063 $e^+ - H$ COLLISIONS BY THE FADDEEV APPROACH. Banerji, G.; Ghosh, A.S.; Sil, N.C. (Department of Theoretical Physics, Indian Association for the Cultivation of Science, Calcutta-32, India). Phys. Rev. A 7: No. 2, 571-577 (Feb 1973).

The positron–hydrogen collision problem has been investigated by the Faddeev formalism as used by Sloan and Moore. The cross sections for the elastic scattering and the positronium formation have been calculated above the positronium-formation threshold for the incident positron energy up to 1.36 keV, and the results have been compared with those of other theoretical calculations. Appreciable differences have been found between the present results for the elastic-scattering cross sections and the corresponding results obtained by the first-order Born approximation at energies as high as the order of keV. The proton–positronium–elastic-scattering cross sections are also reported. These cross sections which

vanish in the first-order Born approximation are found to be significant at low incident proton energies. (auth)

31064 TRANSITION PROBABILITIES AND MULTIPLE IONIZATIONS OF IONS BY HIGH-ENERGY-ELECTRON IMPACT. Hahn, Y.; Watson, K.M. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. A 7: No. 2, 491-499 (Feb 1973).

The single-particle model for atoms and ions is used to calculate the transition probabilities to bound and continuum electronic states. The projection operators in the semiclassical approximation derived previously are applied to treat the large numbers of final states involved. Ionization cross sections of atoms and ions by high-energy-electron impact are then estimated. The ionization cross sections result both from direct transition to the continuum and from inelastic scattering followed by Auger emission. (auth)

31065 DISTORTED-WAVE APPROXIMATION AND ITS APPLICATION TO THE DIFFERENTIAL AND INTEGRATED CROSS SECTIONS FOR ELECTRON-IMPACT EXCITATION OF THE 2 ^{1}P STATE OF HELIUM. Madison, D.H.; Shelton, W.N. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. A 7: No. 2, 499-513 (Feb 1973).

Theoretical results are given for the application of the distorted-wave approximation to electron-atom impact excitation for transitions from an L-S coupled initial state to an arbitrarily coupled final state. Expressions for the differential cross section and spin polarization of the emitted electrons are given for unpolarized electron beams incident upon unpolarized atoms. These results are applied to excitation of helium from its ground state to the 1s2p $^1P_1$ excited state for incident-electron energies between 26.5 and 300 eV. The results are compared with previous theoretical and experimental works. It is found that the distorted-wave calculation is superior to previous calculations in fitting the absolute magnitude and angular distribution of the experimental data. The improvement over the plane-wave calculations is greater at large angles, where the plane-wave approximations fail by several orders of magnitude. (auth)

31066 SPIN POLARIZATION AND DIFFERENTIAL CROSS SECTION FOR ELECTRON-IMPACT EXCITATION OF THE 6s6p $^1P_1$ STATE OF MERCURY: DISTORTED-WAVE TREATMENT. Madison, D.H.; Shelton, W.N. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. A 7: No. 2, 514-523 (Feb 1973).

The results of the distorted-wave theory for electron-impact excitation of atoms are applied to the excitation of the 6s6p $^1P_1$ state of mercury. The spin polarization and the differential cross section are given for unpolarized incident electron beams with energies between 25 and 180 eV. The distorted-wave results are compared with experimental data, and good agreement is found for both the spin polarization and differential cross section. (auth)

31067 DIRECT MEASUREMENT OF THE RATIO BETWEEN THE TRANSFER RATES OF MUONS FROM μp AND μd ATOMS TO XENON IN A GASEOUS TARGET OF DEUTERATED HYDROGEN. Bertin, A.; Bruno, M.; Vitale, A. (Istituto di Fisica dell'Università di Bologna, and Istituto Nazionale di Fisica Nucleare, Sezione di Bologna, Italy); Placci, A.; Zavattini, E. Phys. Rev. A 7: No. 2, 462-469 (Feb 1973).

The ratio B between the transfer rates $\lambda_{\mu p,Xe}$ and $\lambda_{\mu d,Xe}$ of muons from μp and μd muonic atoms to xenon has been directly measured by stopping negative muons in a gaseous target containing deuterated hydrogen and small xenon admixtures at a total pressure of 6 atm abs. and at 293 °K. The results were obtained by analyzing the differential time distribution of the decay electrons coming from muons stopped within the gaseous mixture. In this way one gets $B=1.98\pm0.12$, which supports the dependence of the transfer rates on the mass of the primary muonic atom within 6%. More-precise values for $\lambda_{\mu p,Xe}$ and $\lambda_{\mu d,Xe}$ are also given, i.e., $\lambda_{\mu p,Xe}=(4.53\pm0.15)\times10^{11}$ sec^{-1}, and $\lambda_{\mu d,Xe}=(2.30\pm0.17)\times10^{11}$ sec^{-1}. A lower limit for the scattering cross section σ of μd atoms against xenon is obtained, i.e., $\sigma\geq10^{-15}$ cm^2. (auth)

31068 CURVE CROSSING FOR LOW-ENERGY ELASTIC SCATTERING OF He^+ BY Ne. Bobbio, S.M.; Doverspike, L.D.; Champion, R.L. (Department of Physics, College of William and Mary, Williamburg, Virginia 23185). Phys. Rev. A 7: No. 2, 526-531 (Feb 1973).

The perturbation seen in the experimental differential elastic-scattering cross section for the 40-eV He^++Ne system has been attributed to a single crossing of two intermolecular potential-energy curves. A new theoretical treatment of the curve-crossing problem, namely, that of Delos and Thorson, is employed to obtain the crossing probabilities and phases associated with the crossing. These are determined by utilizing ab initio potentials involved in the crossing and are further used in a partial-wave calculation of the cross section, which is compared with our experiment. The origin of the oscillatory structure observed in the differential cross section is discussed in semiclassical terms by defining the problem in terms of two pseudo-deflection-functions. A rainbow effect is shown to be related to a particular feature (a maximum rather than a minimum) of these deflection functions. (auth)

31069 IONIZATION OF $He(1s^2)$ AND $Li^+(1s^2)$ BY HYDROGEN-ATOM IMPACT. Flannery, M.R. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). Phys. Rev. A 7: No. 2, 531-535 (Feb 1973).

A semiquantal theory based on a binary-encounter approach is applied to the examination of the ionization of $He(1s^2)$ and $Li^+(1s^2)$ by the impact of hydrogen atoms in their ground state with incident energy E above 10 keV. Simultaneous excitations of the projectile atom are explicitly acknowledged. The use of Born's approximation for electron-atom elastic and inelastic scattering results in satisfactory agreement with the Born cross sections for atom-atom collisions. (auth)

31070 ELECTRON-EXCITATION CROSS SECTIONS OF SODIUM BY THE METHOD OF CLOSE COUPLING. Korff, D.F.; Chung, S.; Lin, C.C. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. A 7: No. 2, 545-556 (Feb 1973).

The electron-excitation cross sections of the 3 ^{2}P, 3 ^{2}D, 4 ^{2}S, 4 ^{2}P, 4 ^{2}D, and 4 ^{2}F states have been calculated at several incident energies between 4 and 24 eV by using the method of close coupling. Three different sets of calculations in which the wave functions of the electron-atom system are expanded by three states (3s,3p,3d), by seven states (3s,3p,3d,4s,4p,4d,4f), and by eight states (3s,3p,3d,4s,4p,4d,4f,5p) of the target atom, have been performed in order to investigate how the cross sections are influenced by the indirect coupling of the ground state to the final state through the intermediate ones. The 3 ^{2}D cross sections are found to be about 30% higher than the values obtained by the Born approximation and by the scheme of 3s-3d two-state close coupling. The strong coupling of 3s with 3p and of 3d with 3p provides an indirect coupling between 3s and 3d which is mainly responsible for the large increase of the 3 ^{2}D cross sections over the Born-approximation values. A similar kind of increase in the cross sections is also observed for the 4 ^{2}D state owing to the indirect coupling through the intermediate 3p and 4p states. Inclusion of the intermediate states 3 ^{2}D, 4 ^{2}D, 4 ^{2}S in the close-coupling calculation likewise affects considerably the 3 ^{2}P and 4 ^{2}P cross sections. The effect of indirect coupling is most pronounced in the 4 ^{2}F cross sections (ranging from a four-fold to a ten-fold increase over the Born approximation), because the direct coupling between 3s and 4f is weak and of rather short range so that the major contribution to the cross sections arises from the indirect part. Comparisons of the theoretical cross sections with the experimental values are made. (auth)

31071 GOLD L X-RAY PRODUCTION BY 0.5-30-MeV PROTONS. Shafroth, S.M.; Bissinger, G.A. (University of North Carolina, Chapel Hill, North Carolina 27514); Waltner, A.W. Phys. Rev. A 7: No. 2, 566-571 (Feb 1973).

The characteristic L x-rays of Au, produced by 0.5-30-MeV proton beams on a thin Au target have been observed with a Si(Li) detector. Total L x-ray production cross sections derived from these measurements are in good agreement with presently available theoretical calculations. However, theoretical predictions of $L\alpha/L\beta$ and $L\alpha/L\gamma$ ratios and centroid energies of the $L\beta$ and $L\gamma$ lines as functions of proton energy show that a consistent quantum-mechanical treatment of L-shell ionization gives considerably better agreement with experimental results than the semiclassical or classical theories of inner-shell ionization. (auth)

31072 PROGRAM FOR CALCULATING DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR QUANTUM MECHANICAL SCATTERING PROBLEMS FROM REACTANCE OR TRANSITION MATRICES. Brandt, M. A.; Truhlar, D. G.; Smith, R. L. (Univ. of Minnesota, Minneapolis). Comput. Phys. Commun.; 5: No. 6, 456-477(Jun 1973).

The computer program DCS written in FORTRAN IV for the CDC 6600 computer is described for calculating differential cross sections for general two-body scattering processes involving elastic, inelastic, and rearrangement scattering of an unpolarized beam of elementary or composite particles and an unpolarized target of elementary or composite particles from the relevant transition matrices using the formulas of Blatt and Biedenharn with the Huby correction of the error of Wigner and Eisenbud. The program is applicable to the scattering of electrons, atoms, and molecules from atoms and molecules in the chemical physics energy range and to the scattering of electrons, protons, etc from nuclei in the nuclear physics energy range. (JFP)

31073 GENERAL PROGRAM TO STUDY THE SCATTERING OF PARTICLES BY SOLVING COUPLED INHOMOGENEOUS SECOND-ORDER DIFFERENTIAL EQUATIONS. Chandra, N. (Queen's Univ., Belfast). Comput. Phys. Commun.; 5: No. 6, 427-429(Jun 1973).

The computer program SCAT written in FORTRAN IV for the ICL 1907 computer is described for solving a general set of equations in quantum mechanical scattering theory for coupled second-order differential equations for the scattering of electrons by atoms and molecules and the scattering of nucleons by nuclei. (JFP)

31074 MECHANISM OF ELECTRON ATTACHMENT OF O_2. Koike, F.; Watanabe, T. (Tokyo Univ.). J. Phys. Soc. Jap.; 34: No. 4, 1022-1028(Apr 1973).

Fano's theory on configuration mixing was applied to investigate negative oxygen molecular ion formation in low energy (less than 1 eV) electron collision: $e + O_2 \rightarrow O_2^{-*}$. A cross section formula is obtained. It is found essentially equivalent to Breite-Wigner's one-level formula used by Herzenberg: By the evaluation of the transition matrix element, the mechanism of electron capturing process is investigated and the capture cross section has been expressed in a more explicit form. Attention is paid to two types of transition. Landau–Zener type transition can occur at the crossing point between the adiabatic potentials of $e + O_2$ and O_2^- systems. Another type of transition can occur through the nonadiabatic coupling between the molecular electronic and vibrational states. Either or both of these can play an important role on the transition mechanism. Integrated capture cross section and resonance width of O_2^{-*} state are found to be $0.012\ a_0^3 \cdot eV$ and 4 μeV, respectively, at 82 MeV electron impact (first resonant vibrational level of O_2^{-*} ($v' = 4$)). (auth)

31075 QUANTUM-BEAT G-VALUE MEASUREMENTS ON TRANSITIONS FROM LEVELS OF ALIGNED FAST IONS. Church, D. A.; Liu, C. H. (Univ. of Arizona, Tucson). Physica; 67: No. 1, 90-112(1 Jul 1973).

A technique for measuring Landé g-values using the periods of quantum beats in transitions from excited and aligned levels produced by the collision of a fast ion beam with a thin foil is discussed. The analysis provides a means of evaluating the characteristics of beat-period measurements of this type. Measurements were performed on excited levels of O II, O III, and O IV ions. Perturbations of the beat period produced by optical blends, having used a method of spectrometer refocusing which promises to reduce such blends are discussed. Transitions entering and leaving levels subject to strong optical cascades were investigated to determine if such cascades affect the accuracy of the g-value results. No cascade effects were found. The g-values of the oxygen-ion levels were obtained by a ratio method, using an argon transition from a level with a precisely known g-value as a standard. The results were found to agree with predictions of LS coupling in O II, and with optical Zeeman-effect measurements in O II and O III, when comparison was possible. (auth)

31076 RAINBOW, STUECKELBERG OSCILLATIONS, AND ROTATIONAL COUPLING ON THE DIFFERENTIAL CROSS SECTION OF $Na + I \rightarrow Na^+ + I^-$. Delvigne, G. A. L.; Los, J. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). Physica; 67: No. 1, 166-196(1 Jul 1973).

Relative differential cross sections were measured for the atom-atom collision process $Na + I \rightarrow Na^+ + I^-$ at kinetic energies from 13 to 85 eV. The measurements show two types of oscillating features. The Stueckelberg oscillations are due to the interference of scattering from different potentials inside the pseudo-crossing of the covalent and ionic potential curves. Interference due to scattering from the ionic interatomic potential causes a rainbow structure that was resolved completely. The measurements allow estimations of the covalent potential parameters and the pseudo-crossing parameter H_{12}. Semiclassical differential cross sections were calculated using the lowest-order stationary-phase approximation, JWKB phase shifts and the Landau–Zener transition probability. Substituting the known ionic potential and the determined covalent one, there is a very good agreement between the calculated and measured differential cross sections due to collisions with small and intermediate impact parameters. For large impact parameters a rather serious disagreement arises between the relative intensities as well as the oscillation wavelengths of the corresponding cross section. The intensity discrepancy was removed taking into account the phenomenon of rotational coupling. (auth)

31077 RATE OF CONVERGENCE OF THE FREDHOLM METHOD. Hidalgo, M. B.; Nuttall, J.; Stagat, R. W. (Texas A and M Univ., College Station). J. Phys., B (London); 6: No. 8, 1364-1370(Aug 1973).

It is shown that the method used by Reinhardt et al. (Phys. Rev. Lett.; 28: 401 (1972)) to calculate the Fredholm determinant converges slowly. The dominant term in the error is evaluated and Reinhardt's success in calculating phase shifts is explained. An alternative way of using the Fredholm method is suggested which avoids the need for an extrapolation procedure. (auth)

31078 VELOCITY DISTRIBUTION MEASUREMENTS OF 0.06 TO 1.4 eV ARGON AND NEON ATOMS SCATTERED FROM THE (111) PLANE OF A SILVER CRYSTAL. Subbarao, R. B.; Miller, D. R. (Univ. of California, San Diego, La Jolla). J. Chem. Phys.; 58: No. 12, 5247-5257(15 Jun 1973).

Velocity distribution and out-of-plane density measurements are reported in detail for 0.6 to 1.4 eV argon and neon atoms scattered from the (111) plane of single silver crystals. Incident energies were selected to probe the regime of epithermal scattering where significant changes in scattering direction were previously found to occur. Velocity and density distributions are combined and integrated to yield total transfer coefficients. The change in scattering direction is found not to be related to a transition to structure scattering but rather to a decrease in normal momentum transfer as the total scattering becomes more elastic. Structure scattering effects are more apparent in differential momentum transfer data which show a transfer of momentum from normal to tangential components, in agreement with calculations by McClure. The width of the scattering would therefore be a better parameter to indicate structural effects. An anomaly in the direction of energy transfer also appears which suggests that energy may be transferred from the crystal to the gas even though the mean incident energy may be greater than the mean lattice energy. In general the qualitative results of McClure for differential momentum transfer and of Oman for integrated transfer characteristics of the specific argon–silver interaction appear to be substantially correct. (auth)

31079 EVALUATION OF THE INTERMOLECULAR ENERGY BETWEEN TWO HYDROGEN MOLECULES NEAR THE VAN DER WAALS MINIMUM, FROM A PERTURBATIVE PROCEDURE. Kochanski, E. (Institut de Chimie, Strasbourg). J. Chem. Phys.; 58: No. 12, 5823-5831(15 Jan 1973).

The intermolecular energy between two hydrogen molecules is evaluated from the electrostatic repulsive, and dispersion contributions, which are supposed to be the leading terms. Calculations were carried out for four configurations of H_2-H_2 and the results averaged, these latter values being compared with the available experimental data. Theoretical and experimental results are in fairly good agreement. (auth)

31080 ABSOLUTE EXPERIMENTAL CROSS SECTIONS FOR THE EXCITATION OF BARIUM IONS BY ELECTRON IMPACT. Pace, M. O.; Hooper, J. W. (Georgia Inst. of Tech., Atlanta). Phys. Rev., A; 7: No. 6, 2033-2055(Jun 1973).

The crossed-beam technique was used to measure absolute emission cross sections for the excitation of electric dipole transitions in the Ba^+ ion by electron impact at energies near and below threshold. The basic experimental method involves intersecting modulated ion and electron beams at right angles in a well defined collision volume. A portion of the photon flux radiated from the collision volume by excited ions is detected by an optical system viewing the collision volume along the axis perpendicular to both beams. The total emission is calculated from the portion detected using the experimentally determined response of the detection system to isotropic radiation and a correction for anisotropy, obtained from the polarization of detected emission. The emission cross section is then calculated from the total emission, the two beam currents and their spatial distributions, and the energies. The cross sections measured are absolute in the strict sense that the optical detection system was calibrated with a light standard by a technique which takes into account all spatial and spectral variations. A stable point source of light was devised to determine the variation of the detection-system response with the position in the collision volume where the photons are produced. Another small light source was developed for transferring to the detection system the calibration of a tungsten-ribbon standard of spectral radiance traceable to blackbody standards. Techniques of careful spectral comparison of the sources are used for this purpose. An electron source has been developed with the energy resolution and current necessary for crossed-beam measurements in the 3- to 20-eV range. This tool made possible the examination of the range of impact energies near and below the excitation threshold. (auth)

31081 CONTRIBUTION OF THE METASTABLE $E^3\Sigma_g^+$ STATE TO THE POPULATION OF THE $C^3\Pi_u$ STATE OF N_2 FOLLOWING ELECTRON-IMPACT EXCITATION. Kurzweg, L.; Egbert, G. T.; Burns, D. J. (Univ. of Nebraska, Lincoln). Phys. Rev., A; 7: No. 6, 1966-1971(Jun 1973).

Following low energy electron-impact excitation of molecular nitrogen, the method of delayed coincidence is used to separate the prompt and delayed radiation of the $C^3\Pi_u \rightarrow B^3\Pi_g$ transition. The emission function of the prompt radiation, due to direct C-state excitation, is seen to increase smoothly above threshold. The emission function of the delayed emission, due to collisional

deactivation of metastable states, is composed of two sharp peaks at 12.0 and 12.7 eV as well as a broader peak at about 22 eV. The first of these peaks is recognized as the direct resonant excitation of the metastable $E^3\Sigma_g^+$ state. Evidence is found indicating that the other peaks, which may be associated with the excitation of the $a''^1\Sigma_g^+$ state, lead to indirect excitation of the E state. (auth)

31082 CROSS SECTIONS FOR K-SHELL IONIZATION BY 2-MeV-ELECTRON IMPACT. Li-Scholz, A. (State Univ. of New York, Albany); Colle, R.; Preiss, I. L.; Scholz, W. Phys. Rev., A; 7: No. 6, 1957-1965(Jun 1973).

A systematic study of the cross sections for K-shell ionization by 2.0-MeV-electron impact was made as a function of atomic number. The cross sections for 32 elements from V (Z = 23) to Bi (Z = 83) were first measured relative to each other, and then were normalized to 43 b at Sn (Z = 50). Thus systematic errors usually associated with absolute measurements were minimized and did not obscure minor variations in the Z dependence of the cross sections. The measured values drop from 353 b at V to 9.9 b at Bi. The general trend of the Z dependence of the data is in agreement with theoretical predictions of Kolbenstvedt. However, variations in cross sections by as much as 30% from one element to the next are not accounted for by the theory. (auth)

31083 ION-EXCITED GERMANIUM L-SERIES X-RAY SPECTRA. Burkhalter, P. G.; Knudson, A. R.; Nagel, D. J. (Naval Research Lab., Washington, DC). Phys. Rev., A; 7: No. 6, 1936-1943(Jun 1973).

The Ge $L\alpha_{1,2}$ and $L\beta_1$ spectra obtained by ^4He ion bombardment at 3.0 and 5.0 MeV have major satellite peaks which correspond in energy with those appearing in photon- or electron-excited spectra. Many new satellite peaks can be observed in the ion-induced spectra because of enhanced multiple-vacancy production. An interpretation based on Hartree–Fock–Slater calculations for multiple 3d vacancies gives over-all good agreement for the observed satellite groups for both $L\alpha_{1,2}$ and $L\beta_1$ spectra; however, multiplet calculations are necessary to identify the various satellite components. The continuous satellite structure produced by ^{20}Ne bombardment on Ge at 3.0, 5.0, and 10.0 MeV shows strong self-absorption effects. Published absorption data and variable-take-off-angle experiments were both used to correct for self-absorption. Satellite peaks occur at energies corresponding to multiple $(3d)^n$ plus N-shell vacancies where n has values of 4, 5, and 6. Satellite lines were also identified corresponding to production of $(2p)^2$ vacancies by neon bombardment. (auth)

31084 PERTURBED SYMMETRIC RESONANCE: AN EXACT FORMULA. Crothers, D. S. F. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 8, 1418-1425(Aug 1973).

It is proven that the model transition probability $\sin^2(\tau x)\,\mathrm{sech}^2(\tau y)$ for perturbed symmetric resonance, where τ is the collision time and $x + iy$ is the complex adiabatic action difference integrated along a line joining the point of closest approach to a complex adiabatic degeneracy, is exact not only for (unperturbed) symmetric resonance but also for the Rosen-Zener and the Callaway-Bartling model potential problems. The theories of Stueckelberg (Helv. Phys. Acta.; 5: 369-422(1932)), Demkov (Sov. Phys. JETP; 18: 138-42(1964)) and Nikitin (Chem. Phys. Lett.; 2: 402-4(1968)) are reconciled in that all provide good approximations to the new formula under various different restrictions. Further model potential problems are presented as illustrations of the efficacy of the model formula. (auth)

31085 STATISTICAL ERROR IN MOLECULAR CROSS SECTION MEASUREMENTS. Baldwin, G.C.; Miller, K.J. (Rensselaer Polytechnic Institute, Troy, New York 12181). Rev. Sci. Instrum. 44: No. 7, 860-867 (July 1973).

The probability that a set of counts of particles transmitted over a measured path through a gas at a sequence of pressures can correspond to a particular value of the total cross section is calculated. From this, recipes are given for determining the best value of the cross section and of its mean square deviation, for evaluating the random and systematic errors in the cross sections caused by random fluctuations in gas pressure and errors in the reading of gas pressure, and for prescribing the parameters of an experiment to achieve maximum precision in a given time of measurement. (auth)

31086 THE DIFFUSION CROSS SECTION FOR SCATTERING OF ELECTRONS BY CESIUM ATOMS. Kulik, V.Y.; Kulik, P.P.; Rabyi, V.A. High Temp. 10: No. 4, 643-650 (Mar 1973).

Measurements have been carried out of the electrical conductivity of a weakly ionized cesium plasma which allow the effective electron–cesium atom diffusion cross section to be reconstructed. The critical analysis of the theoretical and experimental results on the diffusion electron–cesium atom cross section published in the literature revealed information characterizing the most probable reliability. A satisfactory reconciliation between the experimental data and the predictions of scattering theory has been revealed. (auth)

31087 MEASUREMENTS OF RECOMBINATION OF ELECTRONS WITH HCO^+ IONS. Leu, M.T.; Biondi, M.A.; Johnsen, R. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. A 8: No. 1, 420-422 (July 1973).

Recombination coefficients of electrons with HCO^+ ions have been determined with a microwave afterglow/mass-spectrometer apparatus. Afterglow measurements of electron density decays in neon–hydrogen–carbon–monoxide mixtures are correlated with the decay of mass-identified ion currents to the wall of the microwave cavity. At the appropriate partial pressures of hydrogen and carbon monoxide in the mixture, the ion HCO^+ dominates the ion composition and its wall current approximately "tracks" the electron density decay curve. From recombination controlled electron-density decay curves, the values $\alpha(HCO^+) = (3.3 \pm 0.5)$ and $(2.0 \pm 0.3) \times 10^{-7}$ cm^3/sec are obtained at 205 and 300 K, respectively. The implications of these results for models of polyatomic-molecule formation in dense interstellar clouds are briefly discussed. (auth)

31088 MEASUREMENTS OF RECOMBINATION OF ELECTRONS WITH H_3^+ AND H_5^+ IONS. Leu, M.T.; Biondi, M.A.; Johnsen, R. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. A 8: No. 1, 413-419 (July 1973).

The electron–ion recombination coefficients for H_3^+ and H_5^+ ions have been determined by means of a microwave afterglow/mass-spectrometer apparatus. Measurements of electron-density decays in helium–hydrogen mixtures are correlated with the decay of mass-identified ion currents to the wall of the microwave cavity. At low partial pressures of hydrogen in the mixture, the ion H_3^+ dominates the ion composition and the ion wall current "tracks" the electron density decay curves. From recombination controlled electron-density decay curves, the values $\alpha(H_3^+) = (2.9 \pm 0.3)$, (2.3 ± 0.3), and $(2.0 \pm 0.2) \times 10^{-7}$ cm^3/sec are obtained at 205, 300, and 450 K, respectively. At higher partial pressures of hydrogen and low temperatures, where H_5^+ is the dominant ion, the value $\alpha(H_5^+) = (3.6 \pm 1.0) \times 10^{-6}$ cm^3/sec is obtained at 205 K. The implications of these results concerning ionization levels in the atmospheres of the outer planets and in the intersteller medium are discussed. (auth)

31089 OBSERVATION OF THE COMPTON MODIFIED BAND FOR THE SCATTERING OF KEV ELECTRONS BY H_2, HE, NE, AND AR. Schmoranzer, H.; Ulsh, R.C.; Bonham, R.A.; Ely, J. (Department of Chemistry, Indiana University, Bloomington, Indiana 47401). J. Chem. Phys. 59: No. 1, 152-157 (1 July 1973).

Measurements of the energy loss spectrum using keV electrons scattered from H_2, He, Ne, and Ar at large scattering angles which define a portion of the Bethe surface are reported. The results are in good agreement with the theory of the Compton effect where the incident x-ray is replaced by a high-energy electron. The angular dependence of the inelastic scattering from H_2, He, and Ne with 45 keV incident electrons is found to be in agreement with the first Born approximation including interference and exchange effects assuming weakly bound target electrons. The ratio of the inelastic peak height to the elastic peak height is compared with the results of the binary encounter theory using Hartree–Fock ground state wavefunctions and the results of experiment and theory are found to be in agreement within experimental uncertainties. (auth)

31090 COLLISIONAL DISSOCIATION OF H_2^+ AND H_3^+ ON MOLECULAR TARGETS LEADING TO FORMATION OF EXCITED HYDROGEN ATOMS. Conrads, R.J.; Ford, J.C.; Thomas, E.W. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). J. Chem. Phys. 59: No. 1, 148-151 (1 July 1973).

Experimental measurements have been made of the cross sections for dissociation of fast (100–700 keV) H_2^+ and H_3^+ ions to give fast H atoms in the 3s excited state; targets for this work were O_2, CO, CO_2, CH_4, C_2H_6, and C_3H_8. The technique involved quantitative measurement of Balmer–alpha radiation emitted from fast moving fragments of the dissociated projectile. Contributions to the Balmer–alpha emission from the 3p and 3d levels were eliminated by a method that utilizes the different lifetimes of the 3s, 3p, and 3d states. It is observed that cross sections for H(3s) formation by dissociation on the hydrocarbons all exhibit essentially the same variation with impact energy and increase in magnitude with the complexity of the target; similar behavior is exhibited by the O_2, CO, and CO_2 group of targets. Comparison of the various cross sections suggests that one cannot assign an effective cross-section value to the constituent atoms of the target molecule. (auth)

31091 HE–BE^{2+} INTERACTION ENERGY AT SMALL INTERNUCLEAR DISTANCES. Harrison, S.W.; Massa, L.J.; Solomon, P. (Department of Chemistry, Hunter College, City University of New York, New York, New York 10021). J. Chem. Phys. 59: No. 1, 263-266 (1 July 1973).

The $He–Be^{2+}$ interaction energy for internuclear separations from 0.16 to 0.79 Å has been determined from single-configuration MO–SCF calculations and compared to that deduced by Giffen and Berry from scattering data. The ratio of the calculated to experimental energies varies from 1.45 at 0.16 Å to 1.03 at 0.79 Å. The large discrepancy between theory and experiment for small internuclear separations is similar to that found by Giffen and Berry from a Thomas–Fermi–Dirac calculation of the interaction energy. The MO–SCF interaction is represented to within 10% by a Born–Mayer potential $V(R) = 944 \exp(-6.23\ R)$ eV with R in angstroms. (auth)

31092 DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR THE EXCITATION OF THE 2 ^{1}S, 2 ^{3}S, AND 2 ^{3}P STATES OF HE BY ELECTRON IMPACT AT 29.6 AND 40.1 EV. Trajmar, S. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). Phys. Rev. A 8: No. 1, 191-203 (July 1973).

Differential and integral cross sections for the electron–impact excitation of the 2 ^{3}S, 2 ^{1}S, and 2 ^{3}P states of He relative to the 2 ^{1}P state have been measured at 29.6– and 40.1–eV energies in the 3° to 138° angular range. The relative cross sections have been normalized to the absolute scale by utilizing the previously determined 2 ^{1}P cross sections [D. G. Truhlar, S. Trajmar, W. Williams, S. Ormonde, and B. Torres (unpublished)]. The differential cross section for the 2 ^{1}S state has a deep minimum at 50°; for the 2 ^{3}P state it is nearly isotropic, and for the 2 ^{3}S state it shows a complicated structure which has not been previously reported. The experimental cross sections are compared to the results of quantum–mechanical calculations performed by Truhlar, Yates, Tenney, Cartwright, Steelhammer, and Lipsky using the Born, Born–Ochkur–Rudge, and Glauber approximations for the 2 ^{1}S excitation and the Born–Oppenheimer and the Ochkur–Rudge approximations for the 2 ^{3}S and the 2 ^{3}P excitations. None of the first–order plane–wave calculations predict the observed differential cross sections for these optically forbidden transitions. It is interesting to note, however, that the Ochkur–Rudge model predicts the correct magnitude and approximate shape of the 2 ^{3}P differential cross sections in the whole angular range at these energies. The Glauber approximation shows considerable improvement compared to first–order plane–wave theories in predicting the cross sections for the 2 ^{1}S state. However, at large scattering angles, calculation and experiment differ significantly. It is clear from the present study that more refined calculations are needed to predict angular distributions for these optically forbidden excitations in the 30–40–eV energy region. (auth)

31093 THRESHOLD BEHAVIOR OF INELASTIC–SCATTERING CROSS SECTIONS. Bardsley, J.N.; Nesbet, R.K. (IBM Research Laboratory, San Jose, California 95193). Phys. Rev. A 8: No. 1, 203-206 (July 1973).

The behavior of scattering cross sections near an excitation threshold is examined for the case of long–range potentials. The theory is confirmed by computations of e–Li scattering. Recent observations of threshold structure in e–Na collisions are ascribed to a ^{1}D resonance of Na^-. A true cusp can occur only in the ^{1}P partial cross section. (auth)

31094 REARRANGEMENT COLLISIONS AT VERY HIGH ENERGIES. Shakeshaft, R.; Spruch, L. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. A 8: No. 1, 206-215 (July 1973).

The energy dependence of the charge–exchange cross section in proton–hydrogen–atom collisions at very high energies, within the framework of the Schrödinger equation, has long been a subject of controversy. We attempt to determine the energy dependence of the forward–scattering cross section at very high energies in an arbitrary rearrangement collision involving two heavy particles of masses M_a and M_b and a light particle of mass m, with m initially bound to M_a and finally bound to M_b. In the limits m/M_a, $m/M_b \to 0$ the scattering is entirely in the forward direction and the cross section σ for forward capture is given exactly by the impact–parameter treatment. A Born–type expansion is developed in the impact–parameter treatment for the forward–capture amplitude A. Thus, A is written as a sum of a finite number of Born terms plus a remainder R. The Schwarz inequality can be used to bound R since there are no non–normalizable plane–wave functions—the motion of M_a and M_b is treated classically. We can thereby show that for a certain class of nonsingular interactions the second Born term provides the dominant contribution to σ at high energies, whether or not the Born series converges. (This may be the first example for which it has been shown that the second Born term dominates.) This result makes plausible the dominance of the second Born term in p–H forward charge exchange. (auth)

31095 VARIATIONAL FORMULATION OF THE R–MATRIX METHOD FOR MULTICHANNEL SCATTERING. Oberoi, R.S.; Nesbet, R.K. (IBM Research Laboratory, San Jose, California 95193). Phys. Rev. A 8: No. 1, 215-219 (July 1973).

A variational treatment of the R matrix method for multichannel scattering is given, in which basis functions used for expanding the wave function within a boundary radius r_o need not satisfy specific boundary conditions at r_o. As an illustration, a simple basis set of monomial functions (r^n, n = 1,...,N) is used in a two–channel–model problem with long–range potentials. Excellent results are obtained with ten such functions in each channel. (auth)

31096 SEMICLASSICAL OPTICAL MODEL FOR MOLECULAR COLLISIONS. George, T.F.; Franchino, H.D. (Department of Chemistry, The University of Rochester, Rochester, New York 14627). Phys. Rev. A 8: No. 1, 180-184 (July 1973).

The construction of a semiclassical optical model for molecular collisions to consider explicitly the dynamics of more than a single nuclear degree of freedom is investigated. A sample model is developed for nonreactive systems as the direct multidegree analog of the semiclassical optical model for a single nuclear degree of freedom. In this model all nuclear degrees of freedom, moving in a complex potential, are treated explicitly through the integration of Hamilton's equations of motion in complex time and complex phase space. Calculations are performed for probabilities of elastic collinear collisions of an atom with a diatomic oscillator in its ground vibrational state with excited vibrational states energetically accessible. Agreement is obtained with exact quantum–mechanical results for just the real part of the potential, through variation of an adjustable parameter in the imaginary part of the potential. Extensions and variations of this model toward the simplification of more–complicated calculations on reactive and three–dimensional systems are discussed. (auth)

31097 PRODUCTION OF METASTABLE IONS IN CESIUM ATOM–ELECTRON COLLISIONS. Nygaard, K.J.; Hahn, Y.B. (Department of Physics, University of Missouri–Rolla, Rolla, Missouri 65401). Phys. Rev. A 8: No. 1, 151-156 (July 1973).

The structure in the total electron–impact ionization cross section in cesium can be partially accounted for by the mechanisms of autoionization and excitation ionization of 5p electrons. For electron energies above 17 eV a large fraction of the ions are metastable and can be detected by Auger emission from a metal surface. The experiment was performed in a cesium–atom–electron crossed–beam apparatus, and the metastable ions were counted with a channel electron multiplier. The metastable–ion count rate was a factor of 100 higher than that due to photons from atomic and ionic transitions. We have measured the over–all excitation function for a number of unresolved Cs^+ metastable levels, the lowest being $5d\{[7/2], 3\}$ at 17.02 eV and $5d\{[1/2], 1\}$ at 17.06 eV. (auth)

31098 ROTATIONALLY INELASTIC SCATTERING WITH EFFECTIVE POTENTIALS. Zarur, G.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 59: No. 2, 943-951 (15 July 1973).

Appropriate close–coupled equations and cross–section expressions are derived starting with a previously developed effective intermolecular potential between an atom and a diatomic molecule. A comparison is made between the effective equations and those arising from the use of conventional potentials in close coupling. The effective expressions are algebraically simpler, and fewer effective coupled equations must be solved. Rotationally inelastic cross–section calculations on the $He–H_2$ system are carried out to illustrate the simplifications and also to present a more detailed study of this system. The effective total and differential cross sections agree quite well with previous conventional calculations. In addition, more extensive calculations are presented which include several transitions $J \to J'$ not previously studied: $0 \to 2$, $0 \to 4$, $0 \to 6$, $2 \to 4$, $2 \to 6$, $4 \to 6$ for parahydrogen and $1 \to 3$, $1 \to 5$, $1 \to 7$, $3 \to 5$, $3 \to 7$, $5 \to 7$ for orthohydrogen at total energies up to E = 0.86 eV. The important role of rotation–translation energy transfer is illustrated in these results. Finally, the expected region of validity and realm of usefulness of effective potentials is discussed. (auth)

31099 REACTION OF D_3O^+ WITH D_2: PROTON AFFINITY OF WATER. Cotter, R.J.; Koski, W.S. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 59: No. 2, 784-787 (15 July 1973).

The cross section for the endothermic ion–molecule reaction: $D_3O^+(D_2,O)D_3^+$ has been studied over the energy range 2–70 eV using a tandem mass spectrometer. The projectile beam was found to contain a significant fraction of the D_3O^+ in an excited electronic state which was relatively insensitive to collisional deactivation using high pressures but was readily deactivated using the paramagnetic gas NO in the primary ion source. Threshold measurements, using the ground state D_3O^+ beam, permitted a determination of the proton affinity of water and the conclusion that the reaction proceeded through a persistent intermediate complex at energies close to the threshold. (auth)

31100 ABSOLUTE ELECTRON IMPACT IONIZATION CROSS SECTIONS OF Li IN THE ENERGY RANGE FROM 100 TO 2000 eV. Jalin, R.; Hagemann, R.; Botter, R. (Departement de Recherche et Analyse, Centre d'Etudes Nucleaires de Saclay, BP N°2, 91190 Gif-Sur-Yvette, France). J. Chem. Phys. 59: No. 2, 952-959 (15 July 1973).

The absolute electron impact ionization cross sections for lithium in

the energy range between 100 and 2000 eV were measured by the nonmodulated crossed beam technique. The neutral lithium beam is produced by a Knudsen cell and crossed at right angles with the electron beam. The ions formed are collected on a plate and their intensity determined with a dc amplifier. The neutral beam is condensed on a cold trap cooled with liquid nitrogen, this temperature being much lower than that required to obtain total condensation. The amount of metal deposited is measured by the isotopic dilution technique and by atomic absorption, and the density of the atoms in the neutral beam is calculated. The total absolute ionization cross sections can then be determined. All possible errors have been carefully analyzed and their magnitudes estimated. The absolute ionization cross section for Li at an energy of 500 eV is $Q_{Li}=0.358\times10^{-16}$ cm^2. This value is half of that obtained by McFarland and Kinney. The partial ionization cross sections for the singly and doubly charged ions, is determined with a mass spectrometer attached to this apparatus. For the singly charged ions, the variation of the cross section with the energy of the ionizing electrons is in agreement with the optically allowed transition law Q=A log BE/E. From the variation of Q with E, the squared matrix element of the transition moment $(Mi)^2$ is determined. New calculations of the ionization cross section of Li were performed in the framework of the Born–Bethe approximation as modified by Gaudin and Botter to take into account collisions with large momentum variation of the incident electron. Hartree–Fock type wavefunctions for the ground state atom (tabulated by Clementi) were used. The calculated values are in good agreement with our experimental results and with the former theoretical results calculated by various methods. This work also indicates that the experimental results of McFarland and Kinney for Li are too large. (auth)

31101 MOLECULAR BEAM KINETICS: D + ClF_3. Cross, J. B. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Chem. Phys.; 59: No. 2, 966-967(15 Jul 1973).

The reaction D + ClF_3 → DF + ClF_2 was studied by using the crossed molecular beam technique; it was found to occur at high relative kinetic energies. Laboratory and center-of-mass angular distributions are reported. As the lab distribution was quite insensitive to the c.m. recoil energy distribution, no information about the DF internal excitation could be deduced. (2 figures) (RWR)

31102 DETERMINATION OF INTERATOMIC POTENTIALS BY THE INVERSION OF ELASTIC DIFFERENTIAL CROSS SECTION DATA. III. ^{7}Li–Ar. Klingbeil, R. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). J. Chem. Phys. 59: No. 2, 797-800 (15 July 1973).

A set of phase shifts corresponding to the elastic scattering of lithium off of argon is extracted from a single set of differential cross section data. The phase shifts are inverted to a numerical ^{7}Li–Ar interatomic potential. (auth)

31103 STUDY OF H_2^+ + He → HeH^+ + H AT LOW ENERGIES. Neynaber, R.H.; Magnuson, G.D. (Gulf Radiation Technology, A Division of Gulf Energy and Environmental Systems, San Diego, California 92138). J. Chem. Phys. 59: No. 2, 825-831 (15 July 1973).

Laboratory-energy distributions of HeH^+ were measured for the reaction H_2^++He–HeH^++H (endothermic by 0.81 eV for ground-state reactants and products) with a merging-beams apparatus over a range of interaction energy W from 0.05 to 12 eV. The He was in the ground state; the H_2^+ was vibrationally excited. Absolute and relative cross sections were determined from these distributions. For W ≥ 5 eV, the distributions show that in the center-of-mass system the HeH^+ peaks along both the incident direction of the H_2^+ and the incident direction of the He. The peak along the direction of the He is largest, and is the only one for W < 5 eV. The role played by W and by the vibrational excitation of H_2^+ in the formation of the peaks is discussed. It is not clear what mechanism controls the reaction. The data cannot be satisfactorily explained with either the spectator-stripping or the Langevin model. (auth)

31104 PRODUCTION AND DECAY OF DOUBLE L VACANCIES IN ARGON AND PHOSPHORUS. Rudd, M.E.; Fastrup, B.; Dahl, P. (Institute of Physics, University of Aarhus, DK-8000 Aahus C. Denmark); Schowengerdt, F.D. Phys. Rev. A 8: No. 1, 220-225 (July 1973).

Measurements have been made at two laboratories which indicate that the structure reported at 450–550 eV in the electron spectrum from Ar^+–Ar collisions by Ogurtsov, Flaks, and Avakyan is spurious. It is argued that the double L vacancies which they invoke to explain the structure are more likely to decay by the two-step Auger process L^2–LM^2–M^4 than by the one-step process L^2–M^3 suggested by these authors. Evidence supporting this is found in our electron spectra from P^+–Ar collisions, where it is known from energy-loss and charge-state measurements that double L vacancies are produced in phosphorus. (auth)

31105 ELASTIC SCATTERING OF ELECTRONS AND POSITRONS BY LITHIUM ATOMS. Sarkar, K.; Saha, B.C.; Ghosh, A.S. (Indian Association for the Cultivation of Science, Calcutta-32 India). Phys. Rev. A 8: No. 1, 236-243 (July 1973).

The eikonal approximation has been used to investigate $e^\pm$–Li scattering in the energy region E=0.8 to 500 eV. In addition to the static potential, the effect of the polarization potential has been included explicitly. Our results for the total cross section of e^-–Li scattering in the energy region $4 \leq E \leq 10$ eV are in close agreement with the recent experimental findings as well as with the theoretical results obtained by various authors using the close-coupling approximation. In the energy region $10 < E \leq 500$ eV, the present approach yields higher values than first Born approximation (FBA). Our results for the total cross section for e^+–Li scattering in the eikonal approximation are displayed and compared with the corresponding polarized FBA results and the results obtained by the polarized-orbital method. Results for the differential cross sections for both the systems $e^\pm$–Li in the eikonal approximation are also presented together with the corresponding polarized FBA results. (auth)

31106 CHARGE EXCHANGE: THEORY AND APPLICATION TO PROTON–HYDROGEN–ATOM COLLISIONS. Band, Y.B. (Department of Physics, University of Chicago, Chicago, Illinois 60637). Phys. Rev. A 8: No. 1, 243-251 (July 1973).

A theory of rearrangement collisions taking account of the nonorthogonality of initial and final states is presented. Detailed discussion of the range of validity of the theory is worked out. The method is applied to proton–hydrogen–atom charge exchange collisions. We find that at high energy the Jackson–Schiff results are obtained and that below 100 kev the cross section is raised significantly above the result of Jackson and Schiff. The new result is in better agreement with experimental results than the calculations based on the Jackson–Schiff formulation. (auth)

31107 GLAUBER E^- + HE ELASTIC SCATTERING AMPLITUDE: A USEFUL INTEGRAL REPRESENTATION. Thomas, B.K. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260); Chan, F.T. Phys. Rev. A 8: No. 1, 252-262 (July 1973).

New analytic methods for reducing the Glauber amplitude for charged-particle–neutral-atom collisions to a one-dimensional integral representation involving modified Lommel functions are proposed. To illustrate these new methods, the reduction of the Glauber amplitude for e^- + He elastic scattering, using a simple Hylleraas wave function for the He ground state, is described in detail, and the resulting integral for the amplitude is evaluated numerically. The Glauber-approximation-predicted elastic scattering amplitude previously calculated by Franco from a three-dimensional integral representation, with a more complex Hartree–Fock wave function for the ground state, is also recalculated using these new procedures; these results are in good agreement with those obtained by Franco. Thus, the utility and practicality of these new techniques are demonstrated. The application of these procedures to more-general charged-particle–neutral-atom collisions is discussed. (auth)

31108 CONFIGURATION-INTERACTION EFFECTS IN THE SCATTERING OF ELECTRONS BY ATOMS AND IONS OF NITROGEN AND OXYGEN. Ormonde, S.; Smith, K.; Torres, B.W.; Davies, A.R. (Quantum Systems, Inc., Albuquerque, New Mexico 87108). Phys. Rev. A 8: No. 1, 262-295 (July 1973).

In this paper we report new and improved theoretical electron-impact cross sections involving energy levels of different electronic configurations of atomic nitrogen and oxygen, and some of their ions. The results are expected to be improvements over previously published work, based on a single (ground-state) configuration approximation, because allowance has been made for additional distortion of the target system by the projectile by taking into account the effect of either virtual or real transitions to different terms of excited electronic configurations. The effect of coupling to excited configurations on the total elastic and forbidden cross sections among the ground-state terms of atomic nitrogen and of N iv is discussed in detail. Cross sections are also given for selected transitions to terms of excited configurations in O II, O III, N II, N III, and N IV. Some new autoionizing series in O II and N II are predicted and suggestions are made for their experimental verification. Also, qualitative agreement with recent observations of autodetaching states in atomic oxygen is obtained and the existence of other as yet unobserved states is suggested. The results indicate the need for additional experiments in oxygen and nitrogen and especially a careful measurement of the electron–nitrogen scattering in the energy range 0–5 eV. (auth)

31109 BETHE SURFACE AND INELASTIC AND ELASTIC DIFFERENTIAL CROSS SECTIONS FOR HELIUM OBTAINED BY USE OF 25-KEV INCIDENT ELECTRONS. Wellenstein, H.F.; Bonham, R.A.; Ulsh, R.C. (Department of Chemistry, Indiana University, Bloomington, Indiana 47401). Phys. Rev. A 8: No. 1, 304-314 (July 1973).

The complete electron–impact spectra, including the elastic scattering, for He have been obtained at the scattering angles 1°, 1.5°, 2°, 3°, 4°, 5°, 7°, and 10° using 25–keV incident electrons. The data cover the momentum–transfer region from 0.8 to 7.5 in atomic units (a.u.). Measured intensities were converted approximately to relative generalized oscillator strengths for different values of energy transfer, and placed on an absolute scale by use of the Bethe sum rule. Although sum–rule normalization using the energy–loss spectrum at a fixed angle is not rigorous, it is justified in the large–angle high–energy limit. Comparison of the results with the theory proved that use of sum–rule normalization was justified at angles as small as 1°. The first–Born theory was shown to be in agreement with experiment over the complete data range. In the case of the binary–encounter theory, good agreement with experiment was obtained from momentum–transfer values greater than 4 a.u. Below 4 a.u. substantial deviations were observed, especially in regions removed from the maximum of the spectral distribution. Sums of the generalized optical–oscillator strength, the x–ray incoherent–scattering factor S(K), the elastic differential, and total scattering cross sections were all computed from the experimental data. The experimental values of S(K) and the elastic differential cross section agreed with accurate theoretical calculations to an average accuracy of 2%. Compton profiles obtained at 5°, 7°, and 10° were found to be in excellent agreement with previous electron–impact, x–ray, and γ–ray measurements. The unresolved autoionizing double excitations (2s2p, $2p^2$, etc.) at an energy loss of 60 eV were observed at both 1° and 2.7°. The 2^1P–1^1S transition at 21.2 eV was also a prominent feature of the Bethe surface and could still be observed at angles as large as 4°. (auth)

31110 APPLICATION OF THE NONITERATIVE–INTEGRAL–EQUATION METHOD TO ELECTRON– HYDROGEN SCATTERING. Smith, E.R.; Henry, R.J.W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. A 8: No. 1, 572-575 (July 1973).

A noniterative–integral–equation method (NIEM) is successfully applied to S–wave scattering of electrons by atomic hydrogen. Reactance–matrix elements and partial–wave cross sections are computed for energies above and below the n = 2 threshold. The results are stable despite the strong degenerate dipole coupling between the 2s and 2p channels. In addition, it is demonstrated, by locating the first ^1S resonance, that the NIEM works in the resonance region below threshold. (auth)

31111 INTERMOLECULAR POTENTIALS FROM CROSSED BEAM DIFFERENTIAL ELASTIC SCATTERING MEASUREMENTS. VIII. He + Ne, He + Ar, He + Kr, AND He + Xe. Chen, C. H.; Siska, P. E.; Lee, Y. T. (The James Franck Institute and Department of Chemistry, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys., 59: No. 2, 601-610 (15 July 1973).

Interatomic potentials for He–rare gas pairs have been obtained by fitting a multiparameter potential to low energy differential cross sections and second virial coefficients. There appears to be no single reduced potential which is valid for all He–rare gas systems; all asymmetric He–rare gas potentials have wider attractive wells than that of He_2. r_m and ϵ for He–Ne, He–Ar, He–Kr, and He–Xe are 3.21 Å, 14.3°K; 3.54 Å, 24.2°K; 3.75 Å, 24.7°K: and 4.15 Å, 25.2°K, respectively. Commonly used combining rules do not provide good estimates for well depths of these systems. (auth)

31112 ROLE OF DIRECT AND RESONANT (COMPOUND STATE) PROCESSES AND OF THEIR INTERFERENCES IN THE QUANTUM DYNAMICS OF THE COLLINEAR H + H_2 EXCHANGE REACTION. Schatz, G.C.; Kuppermann, A. (Arthur Amos Noyes Laboratory of Chemical Physics California Institute of Technology, Pasadena, California 91109). J. Chem. Phys. 59: No. 2, 964-965 (15 July 1973).

The close–coupling propagation method of Kuppermann was used to obtain accurate values for the elements of the scattering matrix as a function of the total energy for the collinear collision H + H_2. From these the reaction probabilities, phases, and time delays corresponding to the vibrational states of the reagent and product H_2 were calculated. The above quantities are plotted for the energy ranges 0.80 to 1.00 eV and 1.20 to 1.35 eV. The interference effects are most clearly revealed in an Argand diagram; they result in very significant oscillations in the reaction probability plot, and are to a large extent responsible for the differences between these exact quantum calculations and the corresponding quasi–classical and semiclassical results. (2 figures) (RWR)

31113 NITROGEN IONIZATION IN AN Hg–N_2 DISCHARGE. Goldstein, R. (Jet Propulsion Laboratory, Pasadena, California 91103). J. Chem. Phys.; 59: No. 2, 983-984(15 Jul 1973).

Ionization products of a mercury vapor–nitrogen discharge were studied as a function of N_2 partial pressure. Below pressures of about 10^{-5} torr the nitrogen ion peaks increased quadratically with pressure; this dependence suggests a bimolecular process, such as collision between two excited states. Above about 2×10^{-5} torr the ion peak heights became linear functions of pressure; this result suggests direct ionization. Estimates of the cross section are given. (1 figure) (RWR)

31114 EFFECT OF FINITE SCATTERING VOLUME AND DETECTOR GEOMETRY ON MEASURED ELECTRON–IMPACT SPECTRA IN CROSSED–BEAM EXPERIMENTS. Bonham, R.A.; Wellenstein, H.F. (Department of Chemistry, Indiana University, Bloomington, Indiana 47401). J. Appl. Phys. 44: No. 6, 2631-2634 (June 1973).

Calculations are reported for the effects of finite scattering volume and detector geometry on electron–impact intensity measurements in crossed–beam experiments. The target and projectile beams are assumed to be Gaussian in cross–section shape. Three cases for detector geometry are considered using rectangular apertures. The first case consists of a single rectangular aperture. The second case consists of an additional single slit with slit width perpendicular to the direction of target beam flow located between the scattering volume and the rectangular aperture. The third case consists of two apertures. Correction values for various experimental situations are given and theoretical results for the important case of zero scattering angle are compared with experiment. (auth)

31115 RESONANCES IN ELECTRON IMPACT ON ATOMS. Schulz, G.J. (Department of Engineering and Applied Science, Mason Laboratory, Yale University, New Haven, Connecticut 06520). Rev. Mod. Phys. 45: No. 3, 378-422 (July 1973).

Electrons colliding with atoms can form, at well–defined energies, compound states consisting of the target atom plus the incident electron. The compound states, which are also called "resonances" or "temporary negative ions," often dominate electron collision processes. In this review we discuss the experimental methods which are useful for studying these resonances, and review the results obtained by various investigators. We list the energies and the widths of resonances for H, He, Ne, Ar, Kr, Xe, Li, Na, Hg, and O. The configurations and other properties of resonances in atoms are discussed. Whenever applicable, results are presented in the form of tables and energy level diagrams. (auth)

31116 RESONANCES IN ELECTRON IMPACT ON DIATOMIC MOLECULES. Schulz, G.J. (Department of Engineering and Applied Science, Mason Laboratory, Yale University, New Haven, Connecticut 06520). Rev. Mod. Phys. 45: No. 3, 423-486 (July 1973).

In this review we present the energies, configuration, and other properties of resonances (also called "compound states" and "temporary negative ions") in diatomic molecules. Much of the information is presented in the form of tables and energy level diagrams. Vibrational, rotational, and electronic excitation are discussed whenever these processes have given information on resonances; often these excitation processes proceed via resonances. The paper is divided according to molecular species (H_2, N_2, CO, NO, O_2), but the main conclusions are discussed by the nature of the processes involved. (auth)

31117 EXACT QUANTUM MECHANICAL REACTION PROBABILITIES AND RATE CONSTANTS FOR THE ISOTOPIC COLLINEAR H+H_2 REACTIONS. Truhlar, D.G. (Arthur A. Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91109); Kuppermann, A.; Adams, J.T. J. Chem. Phys. 59: No. 1, 395-402 (1 July 1973).

Quantum mechanical calculations on three of the collinear H+H_2 reactions involving D–substitutions are presented and compared with each other and with previous calculations on the H+H_2 reaction itself. The energy at which the reaction probability becomes appreciable is well predicted by the vibrationally adiabatic model. The reaction probabilities at low energies ("tunneling") are larger than predicted by tunneling through one–dimensional barriers for motion along the reaction coordinate. The deviations of the exact rates from transition state theory with unit transmission coefficient and with transmission coefficients corrected for tunneling and nonclassical reflection are examined. Transition state theory including tunneling is usually very accurate (correct within 20% for rate constants); but the errors are much larger at temperatures below 300°K. Although the main use of the present results is for testing approximate models of reaction, not for comparison with laboratory experiments, it is interesting to note that the isotope effects are in rough agreement with the (noncollinear) experimental ones. The results are used to examine the general validity of treatments of the dynamics which separate effects due to the different modes of motion. (auth)

Atomic Theory

Refer also to abstract 31031.

31118 INFLUENCE OF NUCLEAR SPIN ON THE D_2 OPTICAL PUMPING OF ALKALI VAPORS. Fränz, F. A. (Univ. of Indiana, Bloomington). Z. Phys.; 262: No. 2, 105-118(1973).

Calculations of the influence of nuclear spin and the hyperfine interaction on optical pumping experiments utilizing $D_2(^2P_{\frac{1}{2}} - {}^2S_{\frac{1}{2}})$ alkali metal resonance radiation are reviewed and extended. Equations are formulated which describe pumping in weak, intermediate, and strong magnetic fields. The D_2 pumping technique is shown to yield a model-independent determination of the cross section for the collisional destruction of "orientation" within the $^2P_{\frac{1}{2}}$ state only in the case of an atom possessing decoupled or zero nuclear spin. Calculations of nuclear spin effects recently by Elbel, Koch, and Schneider (EKS) are shown to disagree with earlier work due to EKS' treatment of the depopulation component of the optical pumping equations. (3 tables) (auth)

31119 NUCLEAR-MASS AND ANOMALOUS-MOMENT CORRECTIONS TO THE HAMILTONIAN FOR AN ATOM IN A CONSTANT EXTERNAL MAGNETIC FIELD. Hegstrom, R.A. (Department of Chemistry, Wake Forest University, Winston-Salem, North Carolina 27109). Phys. Rev. A 7: No. 2, 451-456 (Feb 1973).

The Hamiltonian for a many-particle system in a homogeneous magnetic field is constructed by a straightforward extension of previous work on hydrogenic atoms by Grotch and Hegstrom. Relativistic correction terms of order $\alpha^2\mu_B H$ are identical to those obtained many years ago by Abragam and Van Vleck and by Perl and Hughes. In addition, higher-order terms due to the anomalous moments and to nuclear motion are explicitly formulated in the present work. These terms are of orders $\alpha^3\mu_B H$ and $\alpha^2(m/M)\mu_B H$, respectively, and are coming to be within the range of present experimental measurements. (auth)

31120 MANY-BODY PERTURBATION-THEORY CALCULATIONS WITH FINITE, BOUND BASIS SETS. Kaldor, U. (Centre Européen de Calcul Atomique et Moléculaire 91-Orsay, France). Phys. Rev. A 7: No. 2, 427-434 (Feb 1973).

The feasibility of many-body perturbation-theory (MBPT) calculations with hole and particle states expanded in a finite set of bound-type functions is investigated. The correlation energy of atomic beryllium is used as a test case. Particle states with negative and positive energy values are treated uniformly. We find that convergence of individual diagrams to better than 10^{-4} a.u., and similar agreement with Kelly's numerical results can be obtained using basis sets composed of 9s, 7p, 5d, and 4f Slater orbitals for intrashell correlation and a 10s8p6d4f set for the intershell effects. The total correlation energy calculated with these basis functions is in good agreement with experiment. These results indicate that MBPT calculations by the expansion method are indeed feasible. While this method may not be more convenient than the numerical approach for atomic systems, it should be useful for molecular calculations, where finding a suitable complete set of numerical orbitals presents difficult problems. (auth)

31121 S-MATRIX METHOD FOR THE NUMERICAL DETERMINATION OF BOUND STATES. Bhatia, A.K. (National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland 20771); Madan, R.N. Phys. Rev. A 7: No. 2, 523-525 (Feb 1973).

A rapid numerical technique for the determination of bound states of a partial-wave-projected Schrödinger equation is presented. First, one needs to integrate the equation only outwards as in the scattering case, and second the number of needed trials on $\kappa^2(=-E)$, to determine the eigenenergy and the corresponding eigenfunction, are considerably less than in the usual method. As a nontrivial example of the technique, bound states are calculated in the exchange approximation for the e^-–He^+ system and $l=1$ partial wave. (auth)

31122 NUCLEAR-CHARGE-EXPANSION METHOD FOR $(2S^A2P^B - 2S^{A-1}2P^{B+1})$ TRANSITIONS. Laughlin, C.; Dalgarno, A. (Harvard College Observatory and Smithsonian Astrophysical Observatory Cambridge, Massachusetts 02138). Phys. Rev. A 8: No. 1, 39-46 (July 1973).

The nuclear-charge-expansion method is used to calculate the radiative probabilities of the dipole transitions $2s^a2p^b - 2s^{a-1}2p^{b+1}$ of ionic systems. An extensive comparison with more-elaborate calculations and with experimental data shows that after a few stages of ionization the method gives results of uniformly high accuracy. (auth)

31123 VARIATIONAL PRINCIPLES FOR SINGLE-PARTICLE EXPECTATION VALUES IN THE HARTREE-FOCK APPROXIMATION. Sahni, V.; Krieger, J.B. (Department of Physics, Brooklyn College of the City University of New York, New York 11210). Phys. Rev. A 8: No. 1, 65-76 (July 1973).

The formalism developed by the authors for the variational determination of the expectation value of single-particle operators $W = \Sigma_i W(\vec{r}_i)$ via Delves's principle in the Hartree approximation is extended here to the Hartree-Fock approximation by employing a Slater-determinant-type trial wave function and an appropriately antisymmetrized auxiliary function. A set of coupled integral-differential equations for the components of the auxiliary function are obtained by a subsidiary variational minimization of a functional involving the trial wave function, the auxiliary function, the Hamiltonian, and the operator W. Owing to the antisymmetric nature of both the trial and auxiliary functions, an exchange term involving the specific single-particle operator in question appears in these equations. Decoupling approximations are discussed and the equations solved exactly for single-particle operators that depend on the radial distance only. Employing a single-parameter appropriately antisymmetrized product of the 1S and 2S hydrogenic functions as the trial wave function, the formalism in this Hartree-Fock approximation is then applied to both the helium $2\,^3S$ and $2\,^1S$ isoelectronic sequences to obtain analytic expressions for the expectation value of the operators r^n, n = 2, 1, 1, and $\delta(\vec{r})$. The results of these calculations are observed to approximate closely the results of a 2300-parameter calculation due to Accad et al. and in the orthohelium case to be also equivalent to those due to Hartree-Fock. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 31757.

31124 INFLUENCE OF VISCOSITY ON THE MOTION OF NONUNIFORMITIES OF A NONEQUILIBRIUM PLASMA IN A MAGNETIC FIELD. Golubev, V.S.; Dan'shchikov, E.V.; Lebedev, F.V. High Temp. 10: No. 4, 789-791 (Mar 1973).

When plasma moves in narrow discharge gaps and when large nonuniformities move in closed toroidal channels, the whole mass of gas is brought into motion and allowance must be made for the forces of viscosity throughout the entire volume of gas. Results are presented here from a theoretical study of the motion of a plasma under just such conditions. (LMT)

31125 NUMERICAL SOLUTIONS OF PLANAR AND SPHERICAL MAGNETOHYDRODYNAMIC BLAST WAVES. Rimer, N.; Jen, N.C. (The City College of the City University of New York, New York, New York 10031). J. Appl. Phys. 44: No. 7, 3091-3095 (July 1973).

The effect of a uniform magnetic field on the expansion of an isothermal high-pressure sphere of plasma (fireball) into a fully ionized atmosphere is investigated. The ideal magnetohydrodynamic (MHD) equations in Lagrangian coordinates are integrated numerically using the von Neumann-Richtmyer method of artificial viscosity. Numerical solutions are obtained to the unsteady two-dimensional spherical blast wave model and to the simpler planar one-dimensional model. For large magnetic fields, both a fast and a slow MHD shock wave propagate ahead of the fireball which is deformed into an elliptic shape with major axis in the direction of the uniform magnetic field. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

31126 SOFTWARE CONCEPTS FOR LARGE APPLICATION PROGRAMS. Boeck, R. K.; Pagiola, E.; Zoll, J. (CERN, Geneva). Comput. Phys. Commun.; 5: No. 6, 400-403(Jun 1973).

A practical implementation of programing concepts is given which is believed to be necessary parts of large application programs. They proved successful in the analysis of events involving elementary particles in track chambers. The user community for such programs consists of scientists with a wide geographical spread and access to computers of almost any make. (auth)

Electromagnetic

Refer also to abstracts 31163 and 31355.

31127 (CONF-730301-P2, pp 891-892) HIGH-ENERGY ELECTRON SCATTERING FROM ^{12}C. Heimlich, F. H. (Univ., Freiburg i. B.); Roessle, E.; Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D.; Bienlein, J. K.; Bleckwenn, J.; Dinter, H. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31128 (CONF-730301-P2, pp 895-896) ELASTIC ELECTRON-DEUTERON SCATTERING MEASUREMENTS AND THE NEUTRON CHARGE FORM FACTOR AT VERY LOW MOMENTUM TRANSFERS. Buskirk, F. R.; Dally, E. B.; Dyer, J. N.; Maruyama, X. K.; Topping, R. L. (Naval Postgraduate School, Monterey, CA). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31129 NUCLEON COMPTON SCATTERING AT 6 GeV AND VERY SMALL MOMENTUM TRANSFER. Criegee, L.; Franke, G.; Giese, A.; Poelz, G.; Timm, U.; Werner, M.; Zimmermann, W. (Deutsches Elektronen-Synchrotron, Hamburg). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft. Part B, particle physics; Heidelberg, Germany (21 Feb 1973).

The Compton scattering of 6 GeV photons on protons and deuterons has been investigated for very small scattering angles in order to determine the forward cross section. The energy and the direction of the scattered quanta were measured by means of a pair spectrometer with spark chambers. A squared momentum transfer between 0.007 and 0.09 $(GeV/c)^2$ was covered by the apparatus. Differential cross sections are given and discussed. (auth)

31130 ELECTRON-POSITRON ELASTIC SCATTERING AT A CENTER-OF-MASS ENERGY OF 4 GeV. Madaras, R.; Averill, R.; Hanson, G.; Hofmann, A.; Koch, J.; Law, L.; Law, M.; Leong, J.; Litke, A.; Little, R.; Mieras, H.; Newman, H.; Paterson, J.M.; Pordes, R.; Sisterson, J.; Strauch, K.; Tarnopolsky, G.; Voss, G.; Wilson, R.; Winick, H. (Harvard University, Cambridge, Massachusetts, 02138). Phys. Rev. Lett. 30: No. 11, 507-510 (12 Mar 1973).

We have measured the cross section for electron-positron elastic scattering at 4 GeV center-of-mass energy for scattering angles between 50° and 130°. We have calculated the theoretical (quantum-electrodynamics) cross section including a radiative correction calculated using the peaking approximation. The ratio of the experimental and theoretical cross sections is 0.88 ± 0.10. We therefore obtain new bounds on the quantum-electrodynamics breakdown parameters, $\Lambda_+ > 12$ GeV and $\Lambda_- > 6$ GeV. (auth)

31131 COINCIDENCE ELECTROPRODUCTION OF CHARGED PIONS AND THE PION FORM FACTOR. Brown, C.N.; Canizares, C.R.; Cooper, W.E.; Eisner, A.M.; Feldman, G.J.; Lichtenstein, C.A.; Litt, L.; Lockeretz, W.; Montana, V.B.; Pipkin, F.M. (Cyclotron Laboratory, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 1, 92-135 (1 July 1973).

We report measurements of the electroproduction reaction $e^- + p \rightarrow e^- + \pi^+ + n$ carried out at the Cambridge Electron Accelerator by observing the final electron and pion in coincidence. The apparatus consisted of two focusing magnetic spectrometers equipped with wire spark chambers for determining the trajectories of the particles and with Čerenkov counters for particle identification. Data were collected in three scans which varied in turn one of the three variables: the photon mass sqaured k^2, the virtual photon–hadron center-of-mass energy W, or the angle θ between the virtual photon and the electroproduced pion in the virtual-photon–hadron center-of-mass system. The k^2-scan central settings were $k^2 = -0.18$, -0.30, -0.40, -0.80, and -1.20 GeV^2 for W = 2.15 GeV and $\theta = 0$ °; the W-scan central settings were W = 1.85, 2.05, 2.15, and 2.50 GeV for $k^2 = -0.30$ GeV^2 and $\theta = 0$ °; the central settings for the θ scan were $\theta = 0$ °, 7 °, and 15 ° for $\phi = 0°$ and 180 ° and for $k^2 = -0.40$ GeV^2 and W = 2.15 GeV. The data are analyzed to determine the longitudinal–transverse interference term and are compared with the predictions of a dispersion-theory calculation by Berends. The dispersion-theory model is used to extract the pion electromagnetic form factor. The result is consistent with $F_\pi = F_1^V$, but a simple ρ-pole form factor cannot be ruled out. (auth)

31132 ELASTIC ELECTRON–PROTON SCATTERING AT LARGE FOUR–MOMENTUM TRANSFER. Kirk, P.N.; Breidenbach, M.; Friedman, J.I.; Hartmann, G.C.; Kendall, H.W. (Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Buschhorn, G.; Coward, D.H.; DeStaebler, H.; Early, R.A.; Litt, J.; Minten, A.; Mo, L.W.; Panofsky, W.K.H.; Taylor, R.E.; Barish, B.C.; Loken, S.C.; Mar, J.; Pine, J. Phys. Rev. D 8: No. 1, 63-91 (1 July 1973).

Electron–proton elastic-scattering cross sections have been measured at the Stanford Linear Accelerator Center for four-momentum transfers squared q^2 from 1.0 to 25.0 $(GeV/c)^2$. The electric (G_{Ep}) and magnetic (G_{Mp}) form factors of the proton were not separated, since angular distributions were not measured at each q^2. However, values for G_{Mp} were derived assuming various relations between G_{Ep} and G_{Mp}. Several theoretical models for the behavior of the proton magnetic form factor at high values of q^2 are compared with the data. (auth)

31133 RECOIL–PROTON POLARIZATION IN NEUTRAL–PION PHOTOPRODUCTION BETWEEN 1000 AND 1800 MEV. Tanaka, N.; Castro, M.M.; Milburn, R.H.; Richards, W.B.; Rutherfoord, J.P.; Stearns, B.F. (Department of Physics, Tufts University, Medford, Massachusetts 02155); Deutsch, M.; Patel, P.M.; Tsipis, K. Phys. Rev. D 8: No. 1, 1-8 (1 July 1973).

Measurements are presented of the recoil–proton polarization for π^0 photoproduction angles near 64 ° in the c.m. system. The steep angular dependence observed by others at lower energies persists to at least 1500 MeV, and the polarization crosses through zero near 63 ° over the entire 900–1600–MeV energy interval. Summary fits are made to available recoil–proton polarization data, 950–1250 MeV, and are found to require terms of order $\cos^3\theta$, but no higher. (auth)

Weak

31134 (CONF-730301-P2, pp 881) ELECTROMAGNETIC FORMFACTORS OF THE PROTON AT LOW FOUR-MOMENTUM TRANSFERS. Borkowski, F.; Peuser, P.; Simon, G.; Walther, V. H.; Wendling, R. D. (Univ., Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31135 (ISN-1972, pp 125-127) TIME REVERSAL INVARIANCE IN THE DECAY OF POLARIZED NEUTRONS. Liaud, P.; Steinberg, R.; Vignon, B. 1972. (In French).

An experimental test of time reversal invariance in the β decay of the neutron is in progress. The apparatus has been constructed and is being installed at the High Flux Reactor of the I.L.L. This experiment should give an order-of-magnitude improvement with respect to previous experiments in sensitivity to the presence of time reversal noninvariance as a result of the availability of a high flux of cold neutrons; neutron conducting guides, which reduce the background and polarize the beam; and an improved detection chamber. (auth)

31136 PION–PION PHASE SHIFT AND FORM FACTORS IN THE DECAYS $K^\pm \rightarrow \pi^+\pi^-e^\pm\nu_e$. Beier, E.W.; Buchholz, D.A.; Mann, A.K.; Parker, S.H.; Roberts, J.B. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania, 19104). Phys. Rev. Lett. 30: No. 9, 399-402 (26 Feb 1973).

We present the results of an analysis of 8141 K_{e4} decays. These include (i) the form factors of the weak hadronic current and their dependences on the invariant di-lepton and di-pion masses, and (ii) the magnitude and dependence on invariant di-pion mass of the π–π scattering phase shift $\delta_s - \delta_p$. (auth)

31137 CASCADE TIME OF NEGATIVE K MESONS IN LIQUID DEUTERIUM. Burnstein, R. A.; Novak, D. P.; Rubin, H. A.; Veirs, V. R. (Illinois Inst. of Tech., Chicago). Phys. Rev., A;

7: No. 6, 2102-2105(Jun 1973).

The cascade time of K^- mesons was measured in liquid deuterium using a deuterium-filled bubble chamber as the particle detector and absorber. The experimental result of $T_{cascade,\ D_2} = 6^{+7}_{-4} \times 10^{-12}$ sec is consistent with results for liquid hydrogen and with the prediction that "Stark-effect mixing" allows rapid capture from s states of high principal quantum number n. (auth)

31138 TEST OF CP NONINVARIANCE IN THE DECAY $K^+ \to \pi^+\pi^0\gamma$. Abrams, R.J.; Carroll, A.S.; Kycia, T.F.; Li, K.K.; Menes, J.; Michael, D.N.; Mockett, P.M.; Rubinstein, R. (Brookhaven National Laboratory, Upton, New York, 11973). Phys. Rev. Lett. 30: No. 11, 500-503 (12 Mar 1973).

A careful search has been made for possible CP-nonconserving differences between $K^+ \to \pi^+\pi^0\gamma$ and $K^- \to \pi^-\pi^0\gamma$ decays. In a sample of over 4000 completely reconstructed decays in the charged-pion kinetic-energy interval of 51 to 100 MeV, the asymmetry is 0.005 ± 0.020, with a systematic uncertainty of ± 0.022, indicating no evidence for a CP-invariance violation. This result, combined with that obtained from the sum spectrum, suggests that the direct emission is largely magnetic dipole. (auth)

31139 MEASUREMENT OF THE Σ^- BETA DECAY RATE AND AN IMPROVED TEST OF THE $\Delta S = -\Delta Q$ SELECTION RULE. Sechi-Zorn, B.; Snow, G.A. (University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 1, 12-18 (1 July 1973).

Analyzing Σ^- hyperons produced by K^- stopping in the 30-in. BNL hydrogen bubble chamber, we have obtained (a) an upper limit for the ratio $\Gamma(\Sigma^+ \to e^+n\nu)/\Gamma(\Sigma^- \to e^-n\nu)$ of 0.018 with 90% confidence and (b) a value for the branching ratio, $\Gamma(\Sigma^- \to e^-n\nu)/[\text{total } \Gamma(\Sigma^-)]$, equal to $(1.05 \pm 0.07) \times 10^{-13}$, in good agreement with existing data. (auth)

Strong (Baryon-induced)

31140 POSSIBLE APPROXIMATION OF EXPERIMENTAL DATA ON THE SECONDARY PION ENERGIES IN NN COLLISIONS IN c.m.s. Keropyan, M. I.; Mamidzhanyan, E. A. Yadern. Fiz.; 18: No. 2, 377-380(Aug 1973). (In Russian).

For a set of experimental data on the averaged secondary pion energy $\langle \epsilon_{\pi C} \rangle$ in NN interactions an empirical dependence on the primary nucleon energy E in lab. system is obtained: $\langle \epsilon_{\pi C} \rangle = 0.34 + 0.016\sqrt{E_{0L}}$ (E_{0L} in GeV units). (auth)

31141 POLARIZATION MEASUREMENT OF ANTIPROTONS SCATTERED ELASTICALLY FROM PROTONS AT 220 MeV. Ohsugi, T. (Hiroshima Univ.); Fujisaki, M.; Kaneko, S.; Murata, Y.; Okamura, K.; Kohno, H.; Fukawa, M.; Hamatsu, R.; Hirose, T.; Kitamura, S.; Mamiya, T.; Yamagata, T.; Emura, T.; Kita, I.; Takahashi, K. Nuovo Cim.; 17A: No. 3, 456-463(1 Oct 1973).

The polarization of scattered antiproton in $\bar{p}p$ elastic scattering was measured at the kinetic energy of 220 MeV by means of double scattering in a bubble chamber. The polarizations obtained are 0.28 ± 0.11, 0.46 ± 0.12, 0.51 ± 0.19 and 0.38 ± 0.31 at the scattering angles 28°, 42°, 56° and 73° in the c.m. system, respectively. These results do not seem to be in good agreement with a prediction given by Bryan and Phillips. These data were also compared with a modified diffraction model. (auth)

31142 HIGH-STATISTICS INVESTIGATION OF THE BROAD T AND U PEAKS IN ANTIPROTON INTERACTIONS. Alspector, J.; Cohen, K.J.; Harrison, W.C.; Maglich, B.; Sannes, F.; Van Harlingen, D. (Rutgers University, New Brunswick, New Jersey, 08903); Cvijanovich, G.; Matin, M.; Oostens, J. Phys. Rev. Lett. 30: No. 11, 511-514 (12 Mar 1973).

We observed broad bumps at 2193 and 2359 MeV in the elastic, inelastic, and annihilation $\bar{p}p$ cross sections. We find that the positions and widths of the structures are invariant to changes in the multiplicity and degree of nonperipheralism. Multiplicity distributions indicate that the structure at 2193 has no contribution from single π production, while as much as 40% of the structure at 2359 could be due to this process. (auth)

31143 MEASUREMENT OF N-P AND N-D TOTAL CROSS SECTIONS FROM 0.7 TO 3.6 GEV/C. Devlin, T.J.; Johnson, W.; Norem, J.; Vosburgh, K. (Physics Department, Rutgers-The State University, New Brunswick, New Jersey 08903); Mischke, R.E.; Schimmerling, W. Phys. Rev. D 8: No. 1, 136-155 (1 July 1973).

We present direct measurements of the total cross section for neutrons on protons and deuterons in the momentum range 0.7 to 3.6 GeV/c. Using these and other nucleon-nucleon total cross sections, we evaluate total cross sections in the pure isospin states. (auth)

31144 MEASUREMENTS OF THE POLARIZATION IN PROTON-PROTON ELASTIC SCATTERING FROM 2.50 TO 5.15 GEV/C. Parry, J.H.; Booth, N.E.; Conforto, G.; Esterling, R.J.; Scheid, J.; Sherden, D.J. (University of Chicago and Enrico Fermi Institute Chicago, Illinois 60637); Yokosawa, A. Phys. Rev. D 8: No. 1, 45-63 (1 July 1973).

In an experiment at the Argonne Zero-Gradient Synchrotron we have measured values of the polarization parameter P(t) in the elastic scattering of negative pions, positive pions, positive kaons, and protons on protons at several incident laboratory momenta from 2.50 to 5.15 GeV/c, and for values of the momentum transfer variable $-t$ from 0.2 to 2.0 $(GeV/c)^2$. The final results from p-p elastic scattering presented here extend our knowledge of the polarization to much larger values of $-t$ than the results of previous measurements. Outstanding features revealed by these polarization data include (1) the development of a dip at about $-t = 0.7$ $(GeV/c)^2$, with (2) a substantial secondary peak at larger values of $-t$ and (3) the gradual diminution of the maximum polarization with increasing energy. It is possible to fit the t dependence of the experimental results with a simple model. The energy dependence of the polarized cross sections is also discussed. (auth)

Strong (Meson-induced)

31145 (ANL/HEP-7336) DIFFERENTIAL CROSS SECTIONS IN $\pi^-p \to K^0\Lambda^0$ AND $\pi^+p \to K^0\Sigma^0$ FROM 3 TO 6 GeV/c. Ward, C. E. W.; Ambats, I.; Lesnik, A.; Meyer, W. T.; Rust, D. R.; Yovanovitch, D. D. (Argonne National Lab., Ill. (USA)). Jul 1973. 14p. Dep. NTIS $3.00.

Thesis. Submitted by A. Lesnik to Chicago Univ., Ill.

The differential cross sections were measured for the associated production reactions $\pi^-p \to K^0\Lambda^0$ and $\pi^-p \to K^0\Sigma^0$ at 3, 4, 5, and 6 GeV/c, with a total of over 40,000 events. It is found that both reactions have exponential forward peaks for $-t$ 0.4 $(GeV/c)^2$, with no indication of forward direction flattening or turnover; the slopes of the forward peaks show little if any variation with momentum; and the two cross sections are equal within experimental error from $-t = 1.2$ $(GeV/c)^2$ out to at least $-t = 2.0$ $(GeV/c)^2$. (auth)

31146 LARGE-ANGLE π^- PROTON ELASTIC SCATTERING AT 14 AND 23 GeV/c. Cornillon, P.; Grindhammer, G.; Klems, J.H.; Mazur, P.O.; Orear, J.; Peoples, J. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York, 14850); Rubinstein, R.; Faissler, W. Phys. Rev. Lett. 30: No. 9, 403-406 (26 Feb 1973).

The differential cross section for π^-p elastic scattering has been measured at 13.8 and 22.6 GeV/c up to $-t=5$ $(GeV/c)^2$. The dips in the angular distribution at $-t \simeq 0.8$ and 2.8 $(GeV/c)^2$ previously observed at lower momenta become less prominent at higher momentum. The $-t=2.8$ $(GeV/c)^2$ dip is still observed at 13.8 GeV/c, but at 22.6 GeV/c it has become a sharp kink in the angular distribution. At large momentum transfers, $d\sigma/dt$ at fixed t is still decreasing with increasing s, but at a slower rate in the 14- to 23-GeV/c region than at lower momenta. (auth)

31147 COHERENT PRODUCTION OF 2, 3, 4, AND 5 π-MESONS BY π^+ NUCLEI INTERACTIONS AT 11.7 GeV/c. Arnold, R. (Univ., Strasbourg); Engel, J. P.; Escoubes, B.; Kurtz, N.; Lloret, A.; Paty, M.; Riester, J. L.; de Unamuno, S.; Gemesy, T.; Janossy, V.; Krasnovsky, S.; Pinter, G.; Posch, M.; Telbisz, F. Nuovo Cim.; 17A: No. 3, 393-410(1 Oct 1973).

π^+-nuclei coherent interactions with 2, 3, 4 and 5 pions in the final state were looked for in a heavy-liquid bubble chamber experiment with direct detection of π^0's. Abundant coherent production was found in the three-pion channels $\pi^+\pi^+\pi^-$ and $\pi^+\pi^0\pi^0$, essentially in the A_1 mass region, but the available statistics did not allow to put in evidence coherence in the 2, 4 and 5π channels, for which upper limits of cross sections are given. The branching ratio $R = \Gamma(A_1 \to \rho^+\pi^0)/\Gamma(A_1 \to \rho^0\pi^+)$ was found to be $R = 0.67 \pm 0.22$. (auth)

31148 OBSERVATION OF A NARROW K^* (1760) IN THE $K\pi$ SYSTEM. Aguilar-Benitez, M.; Chung, S.U.; Eisner, R.L.; Protopopescu, S.D.; Samios, N.P.; Strand, R.C. (Brookhaven National Laboratory, Upton, New York, 11973). Phys. Rev. Lett. 30: No. 14, 672-674 (2 Apr 1973).

We have observed $\gtrsim 4\sigma$ signals at mass 1760 MeV and width < 80 MeV in both the $K\pi$ mass and the Y_2^0-moment spectra from a sample of 5330 events of the type $K^-p \to K^-\pi^+n$ at 7.3 GeV/c. Our evidence for a $K\pi\pi$ decay mode of this resonance is only of marginal statistical significance. We may be observing the same object as that reported previously by Carmony et al., although the detailed structure in our data is different. (auth)

31149 STUDY OF THE DECAY $A_2 \to \eta\pi$ VIA THE REACTION $\pi^-P \to \eta\pi^-P$ AT 6.0 GeV/c. Key, A. W. (National Accelerator Laboratory, Batavia, Illinois, 60510); Conforto, G.; Kramer, M.A.; Underwood, D.; Mobley, R.M.; Prepost, R.; Tompkins, D.H.; Witherell, M.S. Phys. Rev. Lett. 30: No. 11, 503-506 (12 Mar 1973).

The reaction $\pi^-p \to \eta\pi^-p$ at 6.0 GeV/c has been studied at the Argonne zero-gradient synchrotron using optical spark chambers. About 1400 events have been obtained in the range $0.80 < M_{\eta\pi} < 1.55$ GeV/c^2, yielding approximately 1000 events of the type $A_2^- \to \eta\pi^-$, with $0.27 < |t| < 0.42$ $(GeV/c)^2$. No structure is discernible within the A_2 mass

spectrum with an experimental resolution of 7.1 MeV/c^2 [full width at half-maximum (FWHM) = 16.7 MeV/c^2]. A single D-wave Breit-Wigner distribution fits the data with a high confidence level yielding the parameters $M_0 = 1.323 \pm 0.003$ GeV/c^2 and $\Gamma_0 = 0.108 \pm 0.009$ GeV/c^2 for the A_2. (auth)

31150 STUDY OF THE η' PRODUCED IN K⁻P INTERACTIONS AT 2.885 GEV/C. Jacobs, S.M.; Kirsch, L.; Schmidt, P. (Department of Physics, Brandeis University, Walthman, Massachusetts 02154); Chang, C.Y.; Khouri, B.V.; Stottlemyer, A.R.; Yodh, G.B.; Gauthier, P.; Glickman, S.; Goldberg, M.; Meadows, B.; Moneti, G.C.; Brenner, J.; Schneps, J.; Wolsky, G. Phys. Rev. D 8: No. 1, 18-23 (1 July 1973).

We have accumulated a sample of $\sim$ 400 η' (958) decays in the modes (1) $\eta' \rightarrow \pi^+\pi^-\gamma$ and (2) $\eta' \rightarrow \pi^+\pi^-\eta_N{}^0$ (N = neutral decay) from a 15.4-eV/μb study of K⁻p interactions at 2.89 GeV/c. We find a branching ratio R = (1)/(2) = 1.11 $\pm$ 0.18, where (1) is entirely $\eta' \rightarrow \rho^0\gamma$. A matrix-element analysis yields $J^P(\eta') = 0^-, 2^-$ as acceptable values for both samples. Production-decay angular correlations suggest that a $J^P = 2^-$ assignment is unlikely. (auth)

31151 B-MESON PRODUCTION IN π^-D INTERACTIONS AT 7 GEV/C. Cohen, D.; Ferbel, T.; Slattery, P. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 8: No. 1, 23-26 (1 July 1973).

We observe substantial B-meson production in π^-d interactions at 7 GeV/c. The observed mass and width of the B are 1217 $\pm$ 12 MeV and 115 $\pm$ 40 MeV, respectively. We find that the B is produced largely in quasi-two-body final states, and, on the basis of the observed Δ^0B production cross section, we expect a large $\pi A_2 B$ coupling which should be observable in other reactions. (auth)

31152 NEUTRAL ASSOCIATED PRODUCTION BY 8-, 10.7-, AND 15.7-GEV/C π^- INCIDENT ON PROTONS. Foley, K.J.; Love, W.A.; Ozaki, S.; Platner, E.D.; Saulys, A.C.; Willen, E.H. (Brookhaven National Laboratory, Upton, New York 11973); Lindenbaum, S.J. Phys. Rev. D 8: No. 1, 27-38 (1 July 1973).

We present differential and total cross sections for two reactions: $\pi^-p \rightarrow K^0\Lambda$ and $\pi^-p \rightarrow K^0\Sigma^0$. The incident pion momenta were 8, 10.7, and 15.7 GeV/c. The results are based on an analysis of approximately 22 600 events of the two reactions where the π^+ and π^- from the decay of the K_s^0 were detected in the forward leg of the Double Vee Magnetic Spectrometer. The separation of Λ recoils from Σ^0 recoils was accomplished by the missing-mass technique. (auth)

31153 K⁺N CHARGE EXCHANGE AT 3.8 GEV/C. Moninger II, W.; Eisenstein, B.; Kim, J.; Marshall, D.; O'Halloran, T.A.; Robinson, M.; Schultz, P.F. (University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Phys. Rev. D 8: No. 1, 38-44 (1 July 1973).

We have found 431 events of the reaction $K^+d \rightarrow K^*pp$, at 3.8-GeV/c K^+ beam momentum in a 295 000-frame exposure of the Argonne National Laboratory 30-in. deuterium-filled bubble chamber. The event sample consists of one- and two-prong events with a visible K^* decaying to $\pi^+\pi^-$. The total and differential cross sections are found after correction for unseen K^*s and for efficiencies in the scanning-measuring-fitting chain. Comparisons of the data are made to an SU(3) sum rule, a Regge model, and data for $K^-p \rightarrow \bar{K}^*n$. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 31072, 31759, and 31780.

31154 (CONF-730301-P2, pp 1331-1340) POLARIZABILITIES OF NUCLEI AND ELEMENTARY PARTICLES. Ericson, T. E. O. (CERN, Geneva). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Attention is brought to the scant direct information existing on electric and magnetic polarizabilities of both nuclei and elementary particles. Magnitude estimates are given for both from simple models. Slow neutron scattering should be a potentially good source on the neutron electric polarizability. Exotic atoms have measurable polarizability shifts in high orbits as the dominant deviation from Q.E.D. Low frequency Compton scattering provides direct determination in principle of both electric and magnetic nuclear polarizabilities. The correct relation of static polarizabilities to Compton scattering is given. It is shown that spin saturated nuclei should be diamagnets. Strong variations of the nuclear magnetic polarizability is expected as a function of shell structure. Nucleonic polarizabilities may influence nuclear polarizabilities importantly in lighter elements, particularly for magnetic polarizabilities. The possibility of an electric analog to diamagnetism is discussed and shown to be rather large in nuclei, if it exists. (auth)

31155 GENERATING FUNCTIONAL FOR COVARIANT TIME-ORDERED PRODUCTS OF CURRENTS. Shtokhamer, R. (Department of Physics, Technion — Israel Institute of Technology, Haifa, Israel). J. Math. Phys. (N.Y.) 14: No. 5, 623-629 (May 1973).

Assuming that a functional of the form F(A) = T exp(iB(A)) generates covariant time-ordered products of currents, general properties under Lorentz transformations are derived for the expansion coefficients of the functional B(A). The functional B(A) is explicitly constructed for the case of simple commutation relations between currents. The Feynman conjecture is discussed. (auth)

Electromagnetic

31156 (DESY-73/23) A_1 (1070) ELECTROPRODUCTION? Read, B. J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jun 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

A simple estimate of the cross section for electroproduction of the A_1(1070) meson resonance is presented: it could probably be observed in present experiments. The status of the A_1 and the nature of its coupling to the πrho system are summarized. A_1 photoproduction and its production in e^+e^- annihilation are also considered. (auth)

31157 (DESY-73/25) VECTOR MESON PRODUCTION BY AND COMPTON SCATTERING OF POLARIZED PHOTONS OFF POLARIZED NUCLEONS. Fraas, H. (Deutsches Elektronen Synchrotron (DESY), Hamburg (F. R. Germany)). Jun 1973. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

A general analysis of vector meson production by polarized photons off polarized nucleons is presented. Cross section and vector meson decay angular distribution are discussed in terms of s-channel helicity amplitudes for natural and unnatural parity exchange. For the special case of unpolarized target also the recoil polarization is discussed. The question of experiments suitable for analyzing natural and unnatural parity exchange is investigated in detail for the case of rho^0-production. As a special case, Compton scattering is discussed. (auth)

31158 (DESY-73/32) QUARK MODEL PREDICTIONS FOR ELECTROPRODUCTION OF $\frac{3}{2}+$ ISOBARS. Gorczyca, B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jul 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The excited quark model and the additive quark model constraints on the angular decay distributions of B* produced by virtual photons in the process γ(virt)B $\rightarrow$ PB* are obtained. Some of the quark model relations are compared with the experimental data to check the quark model, others are used to obtain for Δ^{++} the ratio of the cross sections for production by longitudinal and transverse photons on protons R = sigma(L)/sigma(T). The agreement of the quark model predictions with experiment is found to be good. (auth)

31159 USE OF FURRY-SOMMERFELD-MAUE WAVE FUNCTIONS IN PAIR PRODUCTION AND BREMSSTRAHLUNG. Fink, J.K.; Pratt, R.H. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15123). Phys. Rev. A 7: No. 2, 392-403 (Feb 1973).

An analytic expression for the differential pair-production cross section is obtained using full Furry-Sommerfeld-Maue wave functions for the electron and positron. It is shown that this expression reduces to the Bethe-Maximon approximation and the Born approximation in the appropriate limits, and that it goes into the corresponding Elwert-Haug approximation for bremsstrahlung via the substitution rule. It is found that the cross sections of the Born approximation and the Bethe-Maximon approximation may be related to the cross section of the present approximation by a normalization theory similar to that used to relate point-Coulomb and screened "exact" calculations for pair production. No such theory works for bremsstrahlung because a larger r region is of importance in the bremsstrahlung process. The region of validity of each approximation is found by comparison with "exact" numerical calculations. There exists a region of low energies and small Z where the present theory for pair production and the Elwert-Haug approximation for bremsstrahlung are valid and are significantly better than the Born and the Bethe-Maximon approximations. The failure of these calculations at low energies for intermediate and high Z is attributed to the fact that the lowest partial waves for the electron and positron, which are dominant at low energies, are very poorly represented in the Furry-Sommerfeld-Maue approximation. (auth)

31160 PHOTOPRODUCTION OF VECTOR MESONS WITH POLARIZED PHOTONS FROM A POLARIZED TARGET. Fraas, H. (Univ., Wuerzburg, Ger.). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft. Part B, particle physics; Heidelberg, Germany (21 Feb 1973).

An investigation is made of the information that can be derived from the decay angular distribution of vector mesons that are pro-

duced from polarized nucleons by polarized photons. Special attention is given to the problem of how information can be obtained, by selecting special polarization modes, namely information on I) the one-pion-exchange and II) the helicity conservation in the exchange of natural parity. In rho-zero production, the effects predicted by the OPE model are estimated. Furthermore, the polarization of the nucleons recoiling from an unpolarized target is investigated. (auth)

31161 MULTIPLICITIES IN LEPTON–HADRON SCATTERING. Cleymans, J. (Technische Hochschule, Aachen). (1973). vp.

From spring meeting of the Deutsche Physikalische Gesellschaft. Part B, particle physics; Heidelberg, Germany (21 Feb 1973).

A relation is discussed in Feynman's version of the parton model between the average multiplicity in deep inelastic electro- and neutrino production at large ω and the average multiplicities in high-energy electron-positron annihilation and hadron-hadron scattering. (GE)

31162 $\nu W2^{en}/\nu W2^{ep}$ AND QUARK-PARTON MODEL. Kim, E. R.; Rodenberg, R. (Technische Hochschule, Aachen). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft. Part B, particle physics; Heidelberg, Germany (21 Feb 1973).

Present data of deep inelastic lepton-nucleon scattering show unambiguously a different behavior of the proton and the neutron and favor partons with nonintegral charges as compared to those with integral charges. A detailed analysis of the difference between the structure function νW_2 for the proton-proton and neutron is incompatible with the quark-parton model. (orig.)

31163 PRODUCTIONS AND DECAYS OF SHORT-LIVED PARTICLES IN e^+-e^- COLLIDING BEAM EXPERIMENTS. Kawasaki, S. (Chiba Univ., Japan); Shirafuji, T.; Tsai, S. Y. (Chiba Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1656-1678(May 1973).

Productions and decays of short-lived particles (e.g., heavy leptons, charmed hadrons and so on) in e^+-e^- colliding beam experiments are investigated. Formulas which are useful for computing the cross section for the production and subsequent decay of a single or a pair of narrow-width particles with spin $\frac{1}{2}$ are derived. Approximate but analytical expressions for the combined angular distribution of the decay products from such particles are derived. The production and decay of a single excited muon is also treated. (auth)

31164 LOW T THEOREMS FOR THE INCLUSIVE PROCESS $e^-p \to e^-\pi$ + ANYTHING AND MINIMAL GAUGE INVARIANT EXTENSION OF ONE PION EXCHANGE. Muetter, K. H.; Rothe, H. J.; Stamatescu, I. O. (Univ., Heidelberg). (1973). vp.

From spring meeting of the Deutsche Physikalische Gesellschaft. Part B, particle physics; Heidelberg, Germany (21 Feb 1973).

Consequences of pion exchange and gauge invariance for the inclusive reaction $\gamma(V) + p \to \pi$ + anything are discussed. A model is presented for a "minimal" gauge invariant extension of pion exchange. Comparison of the model with the existing data on the electroproduction process $e^- + p \to e^- + \pi^+$ + anything shows good agreement. (auth)

31165 SCALING LIMIT OF LONGITUDINAL VIRTUAL COMPTON CROSS SECTIONS. Mandula, J.E. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. D 8: No. 1, 328-330 (1 July 1973).

It is shown that the hypothesis that the quark model gives the correct leading, $\delta'(x^2)$, light-cone singularity of current commutators requires that R, the ratio of longitudinal to transverse virtual Compton cross sections, go to zero like $1/\nu$ in the Bjorken limit. (auth)

31166 DEEP-INELASTIC SCATTERING AND STATIC PROPERTIES OF THE BARYONS IN THE QUARK GLUON MODEL. Broadhurst, D.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Gunion, J.F.; Jaffe, R.L. Phys. Rev. D 8: No. 2, 566-585 (15 July 1973).

The longitudinal structure function $[W_L(q^2, \nu)]$ of inelastic neutrino and electron scattering is studied in the deep-inelastic limit in the canonical quark-gluon model. Although $W_L(q^2, \nu)$ vanishes asymptotically in this model, $\nu W_L(q^2, \nu)$ should scale. Sum rules are derived which relate integrals over the scaling limit of νW_L (q^2, ν) and the well-known structure function $F_2(-q^2/2\nu)$ to octet baryon masses, the Gell-Mann–Oakes–Renner parameter (c), and the pion–nucleon sigma term (σ_π). the sum rules are convergent, since leading Regge terms are to be subtracted off according to a well-known prescription and contain no arbitrary constants if the residues of $\alpha = 0$ singularities in forward current–hadron scattering are polynomials in q^2. The sum rules are derived using light-cone techniques. It is shown that the parton model and Bjorken–Johnson–Low commutators yield identical results. Similar sum rules are presented for other interactions and scalar "quarks." Estimates of c and σ_π allow numerical evaluation of the sum rules indicating that the integrals over $\nu W_L(q^2, \nu)$ are small. The pattern of chiral–symmetry breaking in the vector–gluon model is discussed. It is shown that the dictum that scaling laws may be abstracted from free–field theory leads to difficulties (in that it generates too trivial a theory) if applied to the chiral–symmetry–breaking structure functions of neutrino scattering. Abstraction from gluon models, however, remains adequate. (auth)

31167 CONNECTION BETWEEN EQUAL-TIME AND LIGHT-CONE COMMUTATORS. Abdel-Rahman, A.M.; Taha, M.O. (Department of Physics, University of Khartoum, Khartoum, Sudan). Phys. Rev. D 8: No. 2, 491-496 (15 July 1973).

Integral representations are given for matrix elements of equal–t (equal–time) and equal τ (light–cone) commutators $(t = x_0, \tau = x_0 + x_3)$ of two vector currents. A plausible assumption is made connecting these commutators. Its consequences are corresponding pairs of general variable–mass sum rules. Each pair reduces to a single sum rule in the fixed–mass limit. Electroproduction is discussed as a special case. (auth)

31168 CURRENT ALGEBRA AND GAUGE THEORIES. I. Weinberg, S. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 8: No. 2, 605-625 (15 July 1973).

The methods of current algebra are applied to the problem of calculating corrections to the symmetries of the strong interactions in renormalizable gauge theories of the weak and electromagnetic interactions. The strong interactions are described by a neutral–vector–gluon model, so that their symmetries are just the symmetries of the quark mass matrix, and are determined by the vacuum expectation values of the weakly coupled scalar fields. Corrections to these symmetries are calculated to all orders in the gluon coupling, but only to second order in the gauge coupling e. After putting the results in a gauge–invariant form, it is found that all divergences cancel in the corrections to "natural" symmetries of the strong interactions. The weak interactions can produce corrections to strong–interaction symmetries of the same order of magnitude as the electromagnetic corrections, but such "order α" effects occur only as corrections to the quark mass matrix, and therefore necessarily conserve parity, strangeness, charm, etc., and may produce only isovector corrections to isotopic–spin conservation. It is suggested that these weak–interaction effects of order α are responsible for the nonelectromagnetic corrections to isotopic–spin conservation which seem to be needed in calculations of mass differences and η decay. (auth)

31169 LEPTON SCATTERING IN THE GEORGI-GLASHOW THEORY. Dicus, D.A. (Department of Physics and Astronomy, University of Rochester Rochester, New York 14627). Phys. Rev. D 8: No. 1, 338-341 (1 July 1973).

The effects of the physical scalar on the three reactions, $e^+e^- \to \mu^+\mu^-$, $e^\pm e^- \to e^\pm e^-$, are calculated in the Georgi–Glashow theory. A relation is found between the contribution of the scalar to these cross sections and the mass of the heavy lepton which can be used to completely test the theory, regardless of the masses of the particles, and without resorting to experiments involving hadrons. (auth)

31170 MULTICHANNEL–DISPERSION–THEORY CALCULATION OF PHOTOPION PRODUCTION. Ball, J.S. (University of Utah, Salt Lake City, Utah 84112); Campbell, R.R.; Shaw, G.L. Phys. Rev. D 8: No. 1, 232-240 (1 July 1973).

We have performed a multichannel–dispersion–relation calculation of low–energy ($E_\gamma \lesssim 450$ MeV) pion photoproduction. We are able to fit the present γp data along with the less–well–known $\gamma n \to \pi^- p$ data without the introduction of an $I = 2$ electromagnetic current. Predictions for the reaction $\gamma n \to \pi^0 n$ are made. Parameters are introduced to describe the photoproduction Born terms for the inelastic hadronic channels. We find that through the rescattering integrals, the inelastic effects strongly influence the $\gamma N \to \pi N$ amplitudes even at low energy (in particular, in the E_{0+} and M_{1-} multipoles). (auth)

31171 FIXED–POLE ANALYSIS OF THE DEUTERON COMPTON AMPLITUDE. Gunion, J.; Suaya, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 1, 156-159 (1 July 1973).

Using standard finite–energy sum rules we evaluate the $\alpha = 0$, energy–independent real part of Compton deuteron scattering. In contrast with the proton and neutron cases, the result is not consistent with the Thomson limit. (auth)

31172 PRECISE HYBRID FORMULA FOR ELECTROMAGNETIC MASS DIFFERENCES. Eliezer, S. (Department of Physics, Imperial College, Prince Consort Road, London

SW 7, England); Singer, P. Phys. Rev. D 8: No. 2, 672-674 (15 July 1973).

We present the derivation of a mass formula, which relates electromagnetic mass differences of baryons and pseudoscalar mesons and is experimentally accurate within ≈ 2%. The derivation reveals that the new formula is the appropriate hybrid analog to the Coleman–Glashow formula. (auth)

31173 ELECTROMAGNETIC MASS SHIFT IN LIGHT-CONE ALGEBRA. Fayyazuddin (International Centre for Theoretical Physics, Trieste, Italy); Riazuddin. Phys. Rev. D 8: No. 2, 510-512 (15 July 1973).

Within the framework of light-cone algebra, it is shown that it is possible to obtain the electromagnetic mass shift to be finite by requiring that the contribution from the leading light-cone singularity of the current commutator to the absorptive part of the electroproduction is manifestly gauge-invariant to order $1/q^2$. (auth)

31174 DISPERSION INEQUALITIES FOR THE FORWARD COMPTON-SCATTERING DIFFERENTIAL CROSS SECTION. Radescu, E.E. (Institute for Atomic Physics, P.O. Box 35, Bucharest, Romania). Phys. Rev. D 8: No. 2, 513-516 (15 July 1973).

Dispersion inequalities involving integrals of the forward Compton-scattering differential cross section are written down starting from the low-energy theorems and the analyticity properties of the amplitudes. A previous result reported by Okubo is improved, the bounds obtained here being optimal with respect to the information taken as known. (auth)

31175 RENORMALIZATION AND ANALYSIS OF THE COTTINGHAM FORMULA AND THE CONSISTENCY OF SU(3) AND ELECTROMAGNETIC MASS SHIFTS IN PARTON MODELS. Gunion, J.F. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 8: No. 2, 517-532 (15 July 1973).

We show that the divergent pieces of the Cottingham expression for electromagnetic mass shifts may always be identified, by means of structure-function sum rules, with the contributions (to the total mass shift) resulting from the divergent electromagnetic mass shifts and propagator renormalization of the bare partons themselves. This enables one to carry out a renormalization program, to first order in α. The SU(3) and electromagnetic mass shifts of the baryon octet are analyzed and shown to display a substantial consistency with one another. Predictions for fixed poles in the Compton amplitudes of all baryons result once that for the proton is known. In addition we extract quark masses for a given value of the π–N σ term. (auth)

31176 COMMENT ON THE SCHWINGER-TERM SUM RULE. Ezawa, Z.F. (Department of Physics, University of Tokyo, Tokyo, Japan). Phys. Rev. D 8: No. 2, 675-677 (15 July 1973).

It is shown, in a specific field theory, that the operator Schwinger term diverges necessarily and that it is formally given by the sum rule first derived by Jackiw et al. It is also argued that the convergence of the elastic form factors is assured by the Pomeranchuk theorem. (auth)

31177 DIFFERENTIAL CROSS SECTIONS FOR PAIR PRODUCTION BY PHOTONS ON ELECTRONS. Jarp, S.; Mork, K.J. (Institute of Physics, University of Trondheim, Norges Laererhøgskole, Trondheim, Norway). Phys. Rev. D 8: No. 1, 159-168 (1 July 1973).

The cross section for pair production by unpolarized photons on free, unpolarized electrons is differential in four nontrivial variables. This cross section is integrated numerically over two or three of the variables, and various energy spectra and angular distributions are obtained. The calculations are restricted to low photon energies, below 5 MeV, where effects of recoil and exchange are important and may be observed. (auth)

31178 ELECTROMAGNETIC DECAY RATES OF NEUTRAL MESONS. Kotlewski, A.; Lee, W.; Suzuki, M.; Thaler, J. (Physics Department, Columbia University, New York, New York 10027). Phys. Rev. D 8: No. 1, 348-352 (1 July 1973).

A simple model combining vector dominance, SU(3) symmetry, and the ω–ϕ and η–η' mixing hypotheses is in reasonable agreement with all measured electromagnetic decay rates of neutral vector and pseudoscalar mesons. In particular, this model predicts the width of the η' meson to be between 0.7 and 1.7 MeV. (auth)

Weak

31179 $\mu \to e + \gamma$ DECAY IN THE GRIBOV–PONTECORVO MODEL. Shchepkin, M. G. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 1, 153-158(Jul 1973). (In Russian).

The $\mu \to e + \gamma$ decay probability is calculated assuming that a lepton number nonconserving interaction exists. The known upper limits for the parameters characterizing the lepton nonconservation enables one to get a limit for the branching ratio: $W_{\mu\to e\nu}/W_{\mu\to e\nu,\vec{\nu}} < 4 \cdot 10^{-20}$. (auth)

31180 K_{l3} DECAYS AND (1,8) + (8,1) SYMMETRY BREAKING. Uchida, T. (Nagoya Univ., Japan); Suzuki, T. Progr. Theor. Phys. (Kyoto); 49: No. 4, 1298-1311(Apr 1973).

Effects of (1,8) + (8,1) symmetry breaking on K_{l3} form factors are studied in the frame of soft-pion approach and in terms of the generalized σ models. It is shown that the soft-pion theorem for K_{l3} decays given by Weinstein in the presence of (3,3*) + (3*,3) breaking remains unchanged when the (1,8) + (8,1) symmetry breaking is added. It is further shown that, irrespective of whether massive gauge fields are introduced or not, the generalized σ models give too smooth off-shell extrapolation of the amplitudes to reproduce the present experimental values of the parameters $\xi(0)$ and λ_+. As a result, it seems that either the tree approximation (the effective Lagrangian approach) or the approximate chiral SU(2) × SU(2) symmetry must be abandoned. However if a larger value for λ_+ is given by future experiments, the large negative $\xi(0)$ will naturally be understood in this scheme. (auth)

31181 HADRON STRUCTURE AND WEAK INTERACTIONS IN A GAUGE THEORY. Bég, M.A.B.; Zee, A. (The Rockefeller University, New York, New York, 10021). Phys. Rev. Lett. 30: No. 14, 675-677 (2 Apr 1973).

We construct an anomaly-free U(1) ⊗SU(2) gauge model of weak and electromagnetic interactions based on the three-triplet model of hadron structure. The model has a large number of interesting experimental consequences and requires a relatively low value for the mass of charged intermediate vector bosons; while the lower bound is 13 GeV, 18 GeV is the preferred value. (auth)

31182 $\Delta I = 1/2$ RULE IN A GAUGE MODEL. Bég, M.A.B. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 2, 664-667 (15 July 1973).

We present a formulation of the schizon scheme of Lee and Yang which is within the framework of a renormalizable gauge theory and which yields the full octet rule at the SU(3) level. The model contains six massive gauge fields, two charged and four neutral. (auth)

31183 O(4) GAUGE THEORY WITH THREE-TRIPLET QUARKS. Cheng, T.P. (Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 2, 496-503 (15 July 1973).

A theory of electromagnetic and weak interactions based on the O(4) gauge group is formulated along the general program put forward recently by Pais. In our scheme the hadron symmetry SU(3) × SU(3)' is incorporated in such a way that the model has a (kinematical) $\Delta I = 1/2$ rule for nonleptonic weak decays. The lepton assignment may be made to produce CP-violation effects which are more "convergent" without enlarging the gauge group. There is no lower bound to the masses of the intermediate vector bosons, while the upper limit for one of the charged W's is only 18 GeV. The elastic reaction cross sections $\sigma(\nu_\mu e)$ and $\sigma(\bar{\nu}_\mu e)$ are about 1.4 times the usual V – A values. Other physical features of this model are also discussed in some detail. (auth)

31184 ON A CLASS OF GAUGE THEORIES WITH SUPERWEAK CP VIOLATION. Pais, A (Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 2, 625-656 (15 July 1973).

A class of gauge theories is discussed in which the $\Delta S = 0$ and the $\Delta S = 1$ semileptonic decays are mediated by distinct intermediate bosons, whose mass ratio is related to the Cabibbo angle θ. Common features of the models are as follows: θ is well defined only as the result of spontaneous symmetry breaking; μ decay and the semileptonic $\Delta S = 0$, $\Delta S = 1$ decays are in the ratio $1{:}\cos^2\theta{:}\sin^2\theta$ only if CP is maximally violated in the lepton scetor; a breakdown of μe universality related to CP violation; a superweak impact of CP violation on K decays; the mediation through a neutral vector boson of nonleptonic decays which obey $|\Delta I| = 1/2$; and an amplitude $\ll$O(G) for $\nu_\mu e$ scattering. Two distinct types of theories are discussed in detail. (a) The gauge group O(4) reported before. Here the CP-violating parameter needs a renormalization. To O(G), ν_μ–nucleon reactions are possible only if a heavy lepton is produced. (b) O(4) × G, where left- [right-] handed fermions are in O(4) [G] but scalar with respect to G [O(4)]. Here the CP-violating parameter can be made finite if a constraint between electron and muon multiplets is satisfied. Further consequences for this class are the $\bar{\nu}_e$–e and ν_e–e elastic cross sections are $(1 + \sin 2\theta)$ times their respective V – A values, and ν_μ–nucleon reactions are possible with or without production of a heavy lepton. However, the final hadronic state is necessarily "charmed." The example G = U(1) is discussed in detail. The role of partial discrete symmetries is emphasized. (auth)

31185 COMMENT ON THE CANCELLATION OF INFINITIES IN SECOND-ORDER RADIATIVE CORRECTIONS IN UNIFIED GAUGE THEORIES. Mohapatra, R.N.; Vinciarelli, P. (Center for

Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 2, 481-484 (15 July 1973).

Using configuration-space techniques, and assuming canonical equal-time anticommutation relations for quark fields, we exhibit a simple and direct verification of Weinberg's finiteness condition for second-order radiative corrections in unified gauge theories with the strong interactions accounted for to all orders. (auth)

31186 CONSEQUENCES OF SCALING FOR NEUTRINO INTERACTIONS. Paschos, E.A.; Zakharov, V.I. (National Accelerator Laboratory, P. O. Box 500, Batavia, Illinois 60510). Phys. Rev. D 8: No. 1, 215-220 (1 July 1973).

It is shown that the scaling of all three structure functions implies bounds for the mean values of E_μ/E_ν and $Q^2/2ME_\nu$. When the bounds are analyzed in view of the recent CERN data, they become so restrictive that they essentially reduce to equalities. Bounds for $Q^2/2ME_\nu$ are translated into bounds for the integral $\int xF_2^{\nu N}(x)dx$ and are compared with the corresponding integral in electroproduction. Effects induced by the presence of an intermediate vector boson or heavy leptons are also analyzed. (auth)

31187 DOUBLE BETA DECAY AND $\Delta Q = 2$ CURRENTS. Smith, D.; Picciotto, C. (Department of Physics, University of Victoria, Victoria, British Columbia, Canada); Bryman, D. Phys. Rev. D 8: No. 1, 342-344 (1 July 1973).

We present a calculation of double beta decay using a model that is consistent with the Konopinski-Mahmoud lepton-number-conservation scheme. In the model used, the decay occurs via a $\Delta Q = 2$ interaction $N^* \to N + \mu^- + e^-$ followed by the decay $\mu^- \to e^-\bar{\nu}_e\nu_\mu$. We conclude that although similar models incorporating $\Delta Q = 2$ currents may deal adequately with hypothetical processes in which there are no competing mechanisms, this model does not properly explain two-neutrino double beta decay, which may occur through more conventional channels. (auth)

31188 SCALAR-MESON POLE MODEL FOR WEAK PARITY-VIOLATING BARYON-BARYON-MESON VERTICES. McKellar B.H.J. (Department of Theoretical Physics, University of Sydney, Sydney, New South Wales 2006, Australia); Pick, P. Phys. Rev. D 8: No. 1, 265-268 (1 July 1973).

We apply a scalar-meson pole model to the parity-violating hyperon decays and to the parity-violating $NN\pi$ vertex. In this model we obtain the usual octet-dominance results for the hyperon decay amplitudes: the I=1/2 rule, the Lee-Sugawara triangle, and a vanishing amplitude for s-wave $\Sigma^+ \to n + \pi^+$ decay. The model is distinguished from the vector-meson pole models by the fact that it gives the current-algebra sum rule for the parity-violating $NN\pi$ amplitude whereas the vector pole model predicts that this amplitude vanishes in the limit of isospin symmetry. Using the SU(3) $\times$SU(3) σ model for the currents we compute the amplitudes without arbitrary constants and find that they are about half the observed amplitudes.. (auth)

31189 IS THERE A LIGHT SCALAR BOSON?. Resnick, L.; Sundaresan, M.K.; Watson, P.J.S. (Department of Physics, Carleton University, Ottawa, Canada). Phys. Rev. D 8: No. 1, 172-178 (1 July 1973).

In view of recent theoretical interest in the possibility of a light scalar boson ϕ we discuss some of its properties and possible methods for detecting it. Cross sections for its production are typically 10^{-3} of competing processes, with the possible exception of $0^+ \to 0^+$ transitions in nuclei. We also give a general method of determining the mass of a particle from the energy of its decay products alone, which does not seem to be well known. (auth)

31190 SCHEMATIC EXPERIMENT TO SEARCH FOR NEUTRAL WEAK CURRENTS. Mann, A.K.; Primakoff, H. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). Phys. Rev. D 8: No. 1, 196-198 (1 July 1973).

A schematic experiment is described to search, via the reaction $\nu_\mu + p \to \nu_\mu + n + \pi^+$, for a neutral hadronic weak current, either isovector or isotensor, coupled to a neutral leptonic weak current. The analysis of the experiment makes use of the equality of the cross sections for $n + p \to n + n + \pi^+$ and $n + p \to p + p + \pi^-$, dictated by charge symmetry, and is capable of obtaining, at least in principle, an upper limit of less than 1% on the ratio $\sigma(\nu_\mu + p \to \nu_\mu + n + \pi^+)/\sigma(\nu_\mu + p \to \mu^- + p + \pi^+)$. (auth)

Strong (General)

Refer also to abstract 31777.

31191 SCATTERING OF UNSTABLE PARTICLES: V-θ SECTOR OF THE LEE MODEL WITH UNSTABLE. V. Casagrande, F.; Lugiato, L. A. (Univ., Milan). Nuovo Cim.; 17A: No. 3, 464-492 (1 Oct 1973).

A Lee model without stable V-particle is considered. On the basis of a treatment of unstable particles in quantum field theory given in previous papers the $(V-\theta) \to (V-\theta)$, $(V-\theta) \to (N-\theta-\theta)$ and $(N-\theta-\theta) \to (N-\theta-\theta)$ scattering processes with unstable V are studied. The entire sector is solved by one integral equation. The resulting scattering amplitudes coincide with the corresponding ones given by the S-matrix theory. (auth)

31192 HADRON SYMMETRIES AND GAUGE THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Maki, Z. (Kyoto Univ.); Maskawa, T. Progr. Theor. Phys. (Kyoto); 49: No. 3, 1007-1013 (Mar 1973).

A gauge theory of unified weak and electromagnetic interactions is generalized to hadronic systems on the basis of the quartet model satisfying lepton-baryon symmetry. It is proved, in our model, that (a) the pure hadronic parts of the Lagrangian should obey exact chiral SU(4) $\otimes$ SU(4) invariance and (b) the permissible form of symmetry breaking should be limited to $(4,4^*) \oplus (4^*,4)$-like mass terms in a vector gluon theory, which is not assumed to be of chiral SU(4)-singlet. (auth)

31193 FURTHER COMMENTS ON QUARTET MODELS BASED ON FUNDAMENTAL PARTICLES WITH FRACTIONAL CHARGE. Nakagawa, M. (Meijo Univ., Nagoya, Japan); Nitto, H. Progr. Theor. Phys. (Kyoto); 49: No. 4, 1322-1339 (Apr 1973).

Following a previous paper, implications of the quartet models are studied by putting an emphasis on possible tests of basic assumptions made in the ordinary hadron physics. Concept of universal spurion in mass operator is extended to the case of SU(4) symmetry. Quantitative arguments are given for checking the universal form of semi-leptonic current and also of effective interaction of non-leptonic processes. Enhancement of a 15 non-leptonic interaction together with a similarity law is shown to give useful sum rules for super hadron decays. (auth)

31194 RESONANCE CORRELATION AND ZEROS OF SCATTERING AMPLITUDES. Imachi, M. (Kyushu Univ., Fukuoka); Kuroiwa, T.; Toyoda, F. Progr. Theor. Phys. (Kyoto); 49: No. 4, 1233-1250 (Apr 1973).

Low and high energy behavior of H-type (s-t dual) urbaryon rearrangement amplitude is investigated under the assumption that the amplitude is saturated by prominent resonances which obey generalized Ogawa's rule $(\sqrt{l(l+1)}/k \sim 1 \times 10^{-13}$ cm). Two cases of resonance correlation, i.e., correlation with the same sign and one with opposite sign, lead to two kinds of pattern of zeros of scattering amplitudes at low energies. Asymptotically, these zeros tend to Bessel-function-type zeros as energy increases. The results are compared with low energy differential cross sections and polarizations. (auth)

31195 HADRON-HADRON SCATTERING AT LARGE MOMENTUM TRANSFER. Fayyazuddin (Rutherford High Energy Lab., Chilton, Eng.); Riazuddin Nuovo Cim.; 17A: No. 3, 443-455 (1 Oct 1973).

A model for wide-angle hadron-hadron scattering is developed in analogy with our present ideas about deep inelastic lepton-nucleon scattering. The experimental consequences of this model are examined. (auth)

31196 CHIRAL SU(2)$\otimes$SU(2) MIXING AND THE QUARK MODEL OF HADRONS. Gilman, F.J.; Kugler, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California, 94305). Phys. Rev. Lett. 30: No. 11, 518-521 (12 Mar 1973).

We present a simple form for the vector and axial-vector changes, transformed so that their matrix elements between (constituent) quark-model states correspond to measurable transitions between physical states. A comparison with experiment of predictions for pionic transitions is made. (auth)

31197 MULTIPLICITY DISTRIBUTIONS IN HIGH-ENERGY COLLISIONS, AND THE STATISTICS OF THE IDEAL RELATIVISTIC BOSE GAS. Cooper, F.; Schonberg, E. (Belfer Graduate School of Science, Yeshiva University, New York, New York 10033). Phys. Rev. D 8: No. 1, 334-337 (1 July 1973).

Utilizing some assumptions about high-energy collisions that underlie thermodynamic and hydrodynamic models of high-energy particle production, we find simple relationships among the moments of the multiplicity distribution $\langle N^q \rangle$ that are reasonably well satisfied by recent data from the National Accelerator Laboratory (NAL) on π^- production. Using $\langle N_{ch} \rangle = 2E_{cm}^{1/4}$ we obtain a reasonable one-parameter fit to all the NAL multiplicity data except f_2 and f_3 at 100, 200, and 300 GeV. (auth)

31198 THRESHOLD ENHANCEMENTS IN HADRONIC REACTIONS. Margolis, B.; Meggs, W.J. (Physics Department, McGill University, Montreal, Canada); Logan, R.K. Phys. Rev. D 8: No. 1, 199-206 (1 July 1973).

A resonance-dominance picture of reactions is shown to lead to

threshold enhancements in angle-integrated cross sections under a random-sign or oscillating-sign condition for coupling constants. Formulas are derived for threshold-enhanced reaction rates. Application is made to several reactions and compared to measured cross sections. (auth)

31199 QUARK-FRAGMENTATION MODELS FOR VERY-HIGH-ENERGY PRODUCTION PROCESSES. Mongan, T.R. (Sydnay Area Transportation Study, 7 West Street, North Sydney, Australia); van der Merwe, P. du T. Phys. Rev. D 8: No. 1, 189-195 (1 July 1973).

The qualitative features of models for high-energy production processes based on the fragmentation of the dressed quarks assumed to make up hadrons are discussed. It appears that, if quarks are very massive (i.e., quark mass $\simeq$10GeV/c^2), such models could explain in a simple way the experimental elusiveness of quarks, the limitations on transverse momenta observed in production reactions, the average inelasticity observed in cosmic-ray proton interactions, the abundance of pions produced in high-energy collisions, and the large transverse momenta observed in air showers for primary particle energies above 10^6 GeV. (auth)

31200 NONLEADING REGGE POLES IN UNITARY MULTIPERIPHERAL MODELS. Auerbach, S.P. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. D 8: No. 2, 532-541 (15 July 1973).

Unitary multiperipheral models with two input trajectories are presented. It is shown that the nonleading output trajectories play a crucial role in determining the high-energy behavior of such models. (auth)

31201 MEAN PION MULTIPLICITY OF THE HIGH MISSING MASS. Chan, C.F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 8: No. 1, 179-183 (1 July 1973).

The mean pion multiplicity of the high-value missing mass is investigated from a realistic version of the Amati-Bertocchi-Fubini-Stanghellini-Tonin (ABFST) multiperipheral model. It is shown that, for small invariant momentum transfer, the multiplicity is proportional to the logarithm of the missing mass. This can be tested experimentally at a single energy of the big accelerators. (auth)

31202 UNITARY MULTIPERIPHERAL MODEL WITH DIFFRACTIVE PRODUCTION. Skard, J.A.J.; Fulco, J.R. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 8: No. 1, 312-320 (1 July 1973).

A unitary model of multiparticle amplitudes with multiperipheral and diffractive production mechanisms is presented. The model has a bootstrap solution for the elastic amplitude of the form $\{(J-1) + [(J-1)^2 - R_0 t]^{(1/2)}\}^{-1}$, leading to constant total cross sections at high energies. Inelastic cross sections and multiplicity distributions may be predicted in qualitative agreement with experiment. (auth)

31203 LARGE-ANGLE SCATTERING AND THE INTERCHANGE FORCE. Gunion, J.F. ; Brodsky, S.J.; Blankenbecler, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 1, 287-312 (1 July 1973).

A composite model of hadrons is used to discuss high-energy, large-angle scattering for elastic and quasielastic reactions. Arguments are given that constituent interchange should be the dominant interaction at large angles (both $|t|, |u| > m^2$), rather than gluon exchange. Using the asymptotic behavior of the electromagnetic form factors of the hadrons, predictions are made for the energy and angular dependence of a large number of processes. Detailed numerical comparisons with experiments are given for several reactions. A general discussion of the qualitative behavior of large-angle quasi-two-body processes is given. It is shown that data in this region can determine the quantum numbers and wave functions of the constituents. (auth)

31204 MULTIPLICITIES IN DEEP HADRON-HADRON SCATTERING. Savit, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 1, 274-277 (1 July 1973).

We derive an expression for the average multiplicity for an inclusive experiment $a + b \to c + X$, where a, b, and c are hadrons and c is detected with a large transverse momentum. If E_c is the energy of c in the center-of-mass system of a and b, we find $\langle n(s, E_c)\rangle_{deep} \sim (C_{e^+e^-} + C_x)\ln E_c^2 + C_h \ln(\sqrt{s}/2E_c - 1)^2$ as s and the transverse momentum of c get large. If $E_c > \sqrt{s}/4$, the last term is absent. $C_{e^+e^-}$ and C_h are related to the average multiplicities e^+e^- in annihilation and small-angle hadron-hadron scattering, respectively, while C_x is determined by the final hadron density in the hole plateau region. We also apply our method to the semi-inclusive reaction $a + b \to c + d + X$, where c and d both have large $p_\perp$. Finally, we speculate about the value of C_x, and about nonasymptotic relations between multiplicities in various reactions. (auth)

31205 SCALING MODELS OF HIGH-ENERGY MULTIPARTICLE PRODUCTION IN HADRON-HADRON COLLISIONS. Moreno, H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 1, 268-273 (1 July 1973).

Asymptotic high-energy Koba-Nielsen-Olesen scaling of multiplicity distributions is shown to hold in a class of models. The shape of the scaling function is simply related to the shape of the topological cross sections. A statistical study of the models is made and the thermodynamic limit is investigated. An attempt to relate the impact-parameter picture of high-energy elastic hadron scattering and the scaling phenomenon is presented. Special realistic cases are explored in detail. (auth)

31206 SLOPE OF DIFFRACTION SCATTERING AND EFFECTIVE SHAPE OF SPECTRAL FUNCTIONS. Deo, B.B.; Parida, M.K. (Physics Department, Utkal University, Bhubaneswar-4, Orissa, India). Phys. Rev. D 8: No. 1, 249-257 (1 July 1973).

Using considerations of Mandelstam analyticity and conformal mapping, we have related the slope parameters for the forward peaks of pp, $\bar{p}p$, K^+p, and K^-p elastic scattering to equations for the boundaries of spectral functions. From an analysis of the existing data for large values of energies, the effective shape of different spectral functions has been computed. (auth)

Strong (Baryon No. = 0)

31207 (COO-2009-48) ROCOCO A_2 MESONS. Heinz, R. M.; Neal, H. A. (Indiana Univ., Bloomington). 1973. Contract AT(11-1)-2009. 3p. Dep. NTIS $3.00.

A brief survey is given of experimental and theoretical studies on the structure of the A_2 meson. It is reported that the results of an experiment performed by the Indiana spark chamber group show a bell-shaped distribution for the A_2 mass spectra, and that the probability that the A_2 is a dipole of the type observed by CERN is less than 10^{-50}. It is suggested that either the A_2 has exotic characteristics that come and go depending on the details of the experiment, such as beam momentum or the angle of production, or that the A_2 experiments exhibiting splitting had some unknown systematic error. (LBS)

31208 ρ-MESON PROPERTIES IN A NONPOLYNOMIAL LAGRANGIAN THEORY. Patil, R.S.; Patil, S.H.; Sharma, S.K. (Department of Physics, Indian Institute of Technology, Bombay-76, India.). Phys. Rev. D 8: No. 1, 258-264 (1 July 1973).

Two possible explanations of the existence and the properties of the ρ meson are analyzed within the framework of the nonpolynomial Lagrangian. It is found that the ρ meson bootstrapping reciprocally with the B meson in the static $\pi\omega$ scattering provides a qualitatively satisfactory description of the ρ-meson properties. On the other hand, the forces in the $\pi\pi$ scattering are far too weak to generate the ρ meson. The calculations are performed within the framework of the N/D method, and are free of a cutoff parameter. (auth)

31209 LOW-MOMENTUM $\bar{p}p \to \bar{K}K$. Peaslee, D.C. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts). Phys. Rev. D 8: No. 1, 221-223 (1 July 1973).

An analysis of $\bar{p}p \to \bar{K}K$ measurements in the region $P_L \lesssim 700$ MeV/c is made on the basis of a proposed boson triad (ρ', ω', ϕ'). No contradictions appear, and the $\bar{p}p$ channel for the resonances if present is ^3D; but it appears not possible to decide between $^3D_1$ and $^3D_3$. (auth)

31210 RADIATIVE DECAY OF VECTOR MESONS IN AN ALGEBRAIC MODEL FOR HADRONS. Böhm, A.; Nilsson, J.S. (Institute of Theoretical Physics Fack, S-402 20 Göteborg 5, Sweden). Phys. Rev. D 8: No. 1, 207-214 (1 July 1973).

The decay rates for vector meson-pseudoscalar meson + photon have been calculated using the same assumptions as previously used for the decay V-e$\bar{e}$. The results are compared with experimental data. (auth)

31211 COULOMB CORRECTIONS TO $\pi\pi$ SCATTERING. Chen, C.; Cushing, J.T. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. D 8: No. 2, 542-555 (15 July 1973).

A two-particle Klein-Gordon equation, containing corrections for retardation effects in the vector potential, is used to construct the electromagnetic scattering amplitude for the scattering of two equal-mass spinless particles good to order $(v/c)^2$. The amplitude reduces to the nonrelativistic result at low energies and to the quantum-electrodynamic result at high energies and is similar to a form conjectured by Van Hove for pion-nucleon scattering. This amplitude is used to analyze the kinematically elastic scattering of two charged pions in terms of the electromagnetic and isospin phase shifts. (auth)

31212 DO LIGHT PIONS NECESSARILY OBEY THE PARTIALLY CONSERVED AXIAL-VECTOR CURRENT HYPOTHESIS?. Dashen, R. (Institute for Advanced Study, Princeton, New Jersey 08540); Gross, D.J. Phys. Rev. D 8: No. 2, 559-565 (15 July 1973).

We show that a recent derivation of the Adler condition from S-matrix theory requires a strong assumption of pole dominance. A specific multiperipheral model is constructed in which neither the pole-dominance nor the Adler condition are satisfied. (auth)

Strong (Baryon No. = 1)

31213 MODIFIED GOLBERGER-MIYAZAWA-OEHME SUM RULE. Pham, T.N.; Truong, T.N. (Centre de Physique Théorique de l'Ecole Polytechnique, 75230 Paris Cedex 05, France). Phys. Rev. Lett. 30: No. 9, 406-409 (26 Feb 1973).

A modified form of the Goldberger-Miyazawa-Oehme sum rule is given in terms of experimental quantities at finite energy. It can be used either to test dispersion relations or to determine accurately and unambiguously the pion-nucleon coupling constant in terms of πN scattering lengths. (auth)

31214 PARAMETRIZATION OF THE TRANSVERSE-MOMENTUM DISTRIBUTION IN HADRON COLLISIONS. St. Amand. J.; Uritam, R. A. (Boston Coll., Chestnut Hill, MA). Nuovo Cim.; 17A: No. 3, 493-503(1 Oct 1973).

An empirical parametrization of particle production data in hadron collisions is presented whereby the limited transverse-momentum distribution of emitted particles (centered around 0.3 GeV/c) is accounted for in terms of the uncertainty relation, $\Delta x_T \Delta p_T \geq \hbar/2$. By making a precise, consistent definition of the conjugate spatial co-ordinate, (contrary to an earlier suggestion) the dependence of the center in the p_T distribution on incident momentum and type of projectile is accounted for, in close agreement with experiment. (auth)

31215 URBARYON REARRANGEMENT AND D/F RATIOS. Matsuoka, T.; Sawada, S. (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1251-1258(Apr 1973).

It is shown that the experimental values of D/F ratios of s-channel helicity flip and nonflip amplitudes for two-body hadronic reactions deviate appreciably from those of U(6) symmetry and that they have t-dependence. From the viewpoint of urbaryon rearrangement the deviation of D/F ratios from those of U(6) symmetry are interpreted commonly by using an effective mixing parameter of 56-plet and 70-plet U(6) symmetric wave functions. The effective mixing parameter is related to some asymmetry among three urbaryons in the space part of the octet baryon wave function. It is also shown that the values of the D/F ratios ($F_\pm$) of helicity non-flip and flip amplitudes of meson-baryon scattering should lie in the following restricted regions: $|F_+| \geq 1/2$ and $|F_-| \leq 1/2$. (auth)

31216 INTERNAL ORBITAL ANGULAR MOMENTUM AND PARTIAL DECAY WIDTHS OF BARYON RESONANCES. Hirano, M.; Iwata, K.; Matsuda, Y.; Murota, T. (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 49: No. 3, 934-956(Mar 1973).

The partial decay widths to N_π, $_p\Gamma_J^{\Delta(N)}$, of the baryon resonances Δ_J ($J^P = 3/2^+, 7/2^+, 11/2^+, \ldots$) and N_J ($J^P = 3/2^-, 7/2^-, 11/2^-, \ldots$) on the leading trajectory (without radial excitation) are analyzed by the symmetric quark model. It is noticed that the internal spatial wave function of the baryon resonance on the leading trajectory is reasonably well expressible as a product of the kinematical factor and the factor depending on the interaction between quarks. For the latter factor, those of the harmonic oscillator model and some other simple types are adopted. The Γ_J, obtained in this way, shows that its J-dependence can be grasped as a result of L (internal orbital angular momentum) excitation of the composite system. The defect of the nonrelativistic approximation applied to the final nucleon emitted by the highly excited resonance is overcome by introducing the "least velocity frame" of the baryons, which improves the agreement with experiment better than the nonrelativistic harmonic oscillator model in c.m.s. (auth)

31217 BARYON MASS DIFFERENCES IN A GAUGE MODEL OF STRONG AND ELECTROMAGNETIC INTERACTIONS. Georgi, H.; Goldman, T. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts, 02138). Phys. Rev. Lett. 30: No. 11, 514-517 (12 Mar 1973).

We calculate the baryon mass differences in a model of strong and electromagnetic interactions based on a spontaneously broken U(3)⊗U(1) gauge invariance. Good agreement with experimental values is obtained. (auth)

31218 NO-POLE S-MATRIX FIT TO THE Δ (1236) RESONANCE. Fonda, L. (International Centre for Theoretical Physics, Trieste, Italy); Ghirardi, G.C.; Shaw, G.L. Phys. Rev. D 8: No. 1, 353-355 (1 July 1973).

Recently measurements of π-N 3-3 phase shifts have been made to an accuracy of about 0.1 °. We show that the 14 experimental points can be fitted with a 4-parameter no-pole S matrix (having all the usually accepted analytic properties) to a precision of 1°. Whereas this is unacceptable as a fit to the precisely determined Δ^{++}, it is a better accuracy than that for which all the other elementary particle resonances are known. We conclude that one should associate a resonance with a Breit-Wigner form (implying an S-matrix pole) because of the physics in the problem such as a symmetry model, and not because of the ease in fitting certain experimental data. Thus we stress the need for high-accuracy data to help settle the problem of resonances (such as the Z*'s) whose dynamic origin might be questionab.e. (auth)

31219 AMPLITUDES AND MODEL FOR πN BACKWARD SCATTERING AT 6 GEV/C. Hayot, F.; Morel, A. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, BP n°2-91, Gif-sur-Yvette, France). Phys. Rev. D 8: No. 1, 223-232 (1 July 1973).

Using reasonable assumptions concerning the s-channel helicity-nonflip amplitude $M^{3/2}{}_{++}$ of isospin 3/2 in the u channel and the helocity-flip amplitude $M^{1/2}{}_{+-}$, we extract from the data at 6 GeV/c on πN backward scattering the remaining amplitudes. We find that the isospin-3/2 amplitudes can be described in a Regge-pole model with absorption. A description of $M^{1/2}$ amplitudes is given, using degenerate N_α and N_γ trajectories. The N_γ coupling are found to be fairly important, especially in the $M^{1/2}{}_{++}$ amplitude which then has to be strongly absorbed. (auth)

31220 REAL PARTS OF AMPLITUDES AND POLARIZATION OF πN CHARGE-EXCHANGE SCATTERING. Argyres, E.N. (Department of Physics, State University College of Arts and Science, Plattsburgh, New York); Contogouris, A.P.; Svec, M. Phys. Rev. D 8: No. 1, 184-189 (1 July 1973).

Using fixed-t dispersion relations, low-energy phase shifts (or s-channel resonances), and the imaginary parts of the s-channel helicity amplitudes of analyses at 6 GeV, we determine the real parts, the differential cross sections, and the polarizations for $\pi^- p \to \pi^0 n$ at several energies. The approach is parameter-free and almost model-independent, and leads to results in agreement with experiment and with amplitude analyses. (auth)

31221 VENEZIANO-TYPE AMPLITUDES WITH FORM FACTORS FOR πN SCATTERING. Pal, B.K. (Physics Department, Imperial College, London SW7 2BZ, England). Phys. Rev. D 8: No. 1, 241-248 (1 July 1973).

The crossing-symmetric amplitude possessing Regge behavior for πN scattering is constructed using suitable combinations of beta-function terms and t-dependent form factors. The imput parameters obtained from nucleon-pole and low-energy pion-nucleon resonances are being used to predict the charge-exchange polarizations, forward differential cross sections, and $\pi^+ p$ and $\pi^- p$ backward differential cross sections. The theoretical predictions agree reasonably well with experimental data. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 31140.

31222 (ITEF-867) FORMULAS TABLE FOR NN-antiNN SCATTERING IN COMPLEX MOMENTS THEORY. Boreskov, K. G.; Ter-Martirosyan, K. A. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi I Eksperimental'noi Fiziki). 1972. 10p. (In Russian). INIS.

Formulas were obtained suitable for the analysis of data on nucleon-nucleon scattering. It was assumed only the Regge pole and the branching connected with it were significant; with intensified branching it can be neglected at small $t = -x^2$; and the vertices of the formation of n Regge ions (in t channels) can be selected in factorized form. (tr-auth)

31223 PHENOMENOLOGICAL COMPATIBILITY OF THE SELF REPRODUCING-CUT POMERON WITH ARNOLD AND BARNETT'S SHIELDING-CUT MECHANISM IN PROTON-PROTON DIFFRACTION SCATTERING. Fujisaki, H.; Akiba, E. (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 49: No. 3, 914-925 (Mar 1973).

From the phenomenological viewpoint, it is postulated that the Pomeron is approximately represented by an appropriate combination of the self-reproducing branch-cuts (SRC) $\alpha_P(t) = 1 \pm i\gamma\sqrt{-t}$ (γ: real) with weak cut-strength (WCS) and the fixed simple-pole (FSP) $\alpha_P(t) \equiv 1$ with or without Arnold and Barnett's shielding-cut (ABSC) mechanism. In order to investigate phenomenological consequences of this postulate, the presently available data on (1)

the p-p total cross section, (2) the real to imaginary ratio of the p-p forward amplitude and (3) the slope parameter of the p-p elastic peak are analyzed in the framework of strong exchange-degeneracy (SEXD). Under the assumption of an effective-normal-Regge-trajectory of SEXD type, several important conclusions are obtained with regard to the phenomenological compatibility of SRC of WCS with ABSC mechanism. First, the SRC of WCS will be consistent with FSP in the absence of ABSC, if and only if $\gamma \neq 0$. Secondly, the SRC of WCS will be compatible with FSP in the co-existence of two ABSC $\bar{\alpha}_C(t) = 1 - m_\pi^2 + t/4$ and $\bar{\alpha}_C(t) = 1 - m_K^2 + t/4$, if and only if $\gamma \equiv 0$. Thirdly, the SRC of WCS seems to be contradictory to FSP in the presence of an ABSC $\bar{\alpha}_c(t)$ along, irrespective of whether or not $\gamma = 0$. (auth)

31224 EFFECT OF MULTIPARTICLE MOMENTUM CORRELATIONS ON ELASTIC-SCATTERING ANGULAR DISTRIBUTIONS. Lam, C.S.; Sharp, R.T. (Department of Physics, McGill University, Montreal, Canada.). Phys. Rev. D 8: No. 1, 278-287 (1 July 1973).

A formula is derived showing how elastic-scattering angular distributions are affected by multiparticle momentum distributions. In particular, the importance of longitudinal and transverse momentum correlations on the elastic-scattering slope is emphasized. Hwa has recently shown that a simplified diffractive excitation model gives too small a pp elastic-scattering slope and that a simplified multiperipheral model gives too large a slope. The reason behind these findings is discussed and is traced back to their differences in multiparticle momentum correlations, but not to their differences in energy dependences. It is also shown that a general class of models, including the uncorrelated jet model, gives rise to too small a pp elastic-scattering slope. Finally, the cause of failure for the simplified diffractive model is analyzed in detail and an improved diffractive excitation model is suggested. This model gives rise to a larger elastic-scattering slope than the simplified model. It also exhibits a dependence of the diffractive excitation slope on the mass of the excited resonance, in a way that agrees with experiments. (auth)

31225 SIMPLE STATISTICAL MODEL FOR MULTIPLE-PARTICLE PRODUCTION IN HEAVY NUCLEI. Peaslee, D.C. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 8: No. 1, 344-347 (1 July 1973).

A simple statistical model is set up to compare with the apparently different results of previous calculations on the production of high-energy particles in a heavy nucleus by multiperipheral collisions. The discrepancy is resolved in terms of a high sensitivity of the model to the production number n in a primary collision. This sensitivity is greatly reduced by the realistic assumption of $s < 1$ for the survival of reproductive effectiveness per stage of an intranuclear cascade. Flimsy cosmic-ray data suggest $s \approx 0.6$ in the 100-GeV region. (auth)

31226 PROTON-PROTON ELASTIC SCATTERING INCLUDING SPIN. Konig, E. (Physics Department, The City College of the City University of New York, New York, New York 10031). Phys. Rev. D 8: No. 1, 321-327 (1 July 1973).

A model for the description of proton-proton scattering at infinite energies is presented which includes the spin of the interacting particles in a natural way, by an appropriate generalization of the eikonal. Results which agree with current experimental data on several points are presented. In the limit that spin is neglected, previous results given by Chou and Yang are reproduced. An application to $p\bar{p}$ scattering is also discussed. (auth)

31227 DIP IN HIGH-ENERGY P P SCATTERING AND THE PROTON SUBSTRUCTURE. Eilam, G.; Gell, Y. (Department of Physics, McGill University, Montreal 101, Canada). Phys. Rev. D 8: No. 1, 168-171 (1 July 1973).

The recently observed dip in high-energy elastic p p scattering is explained in the framework of models in which the nucleon possesses a layered substructure. (auth)

31228 SIMPLE EMPIRICAL REPRESENTATION OF THE CHARGED MULTIPLICITY DISTRIBUTIONS IN PROTON-PROTON COLLISIONS. Weisberg, H. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). Phys. Rev. D 8: No. 1, 331-334 (1 July 1973).

The charged-prong multiplicity ratios σ_n/σ_{inel}, when considered as a function of the average multiplicity $\langle n \rangle$, are shown to be well represented over a wide energy range by an empirical formula having a single, energy-independent, free parameter. This representation is similar to the one used by Bozóki and co-workers in 1968. It possesses the scaling property recently discussed by Koba, Nielsen, and Olesen. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 31765.

31229 CONFORMAL COVARIANCE IN THIRRING MODEL. Hortacsu, M. (Univ., Istanbul). Nuovo Cim.; 17A: No. 3, 411-416 (1 Oct 1973).

It is shown that for the derivative coupling model and for the Thirring model with anomalous spin the theory is conformally covariant for a quantized set of coupling-constant values. (auth)

31230 SYMMETRIC GROUP AND THE GEL'FAND BASIS OF SU(3). Generalization of the Dirac Identity. Lezuo, K. J. (Univ., Mainz). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft. Part B, particle physics; Heidelberg, Germany (21 Feb 1973).

It is shown that the states of the Gel'fand basis for the representations of U(3) are obtained by symmetrizing the N particle states by means of the orthogonal units of the algebra of the symmetric group S(N). Furthermore, generalizations of the Dirac identity are derived and a relation is given between the symmetrized two and three-particle exchange operators and of the invariants of U(3). (auth)

31231 USER'S GUIDE TO FORTRAN PROGRAMS FOR WIGNER AND RACAH COEFFICIENTS OF SU_3. Akiyama, Y.; Draayer, J. P. (Univ. of Michigan, Ann Arbor). Comput. Phys. Commun.; 5: No. 6, 405-415 (Jun 1973).

The computer program SU3 WIGNER & RACAH COEFFICIENTS written in FORTRAN IV for the IBM 360/67 computer is described for calculating $SU(3) \supset SU(2) \times U(1)$ and $SU(3) \supset R(3)$ Wigner coefficients as well as SU(3) Racah coefficients for arbitrary couplings and multiplicity. (JFP)

31232 NULL-PLANE FORMALISM AND POLARIZATION. Chakrabarti, A.; Darzens, C. (Centre de Physique Théorique de l'Ecole Polytechnique, 17, rue Descartes, 75230 Paris, Cedex 05, France). Phys. Rev. D 8: No. 2, 586-597 (15 July 1973).

A systematic study is made of the properties of spin in the context of null-plane (or "infinite-momentum") formalism, where the spin projection is invariant under the action of a Galilean subgroup of the Poincaré group. We give explicitly its relations with the helicity and the canonical formalism. The crossing relations and the structure of kinematic singularities of the corresponding amplitudes are studied. It is shown that these amplitudes can be kinematically regularized in a fairly simple fashion. Reduction of direct products and partial-wave expansions are also discussed and some particular simple properties are pointed out. (auth)

31233 GENERALIZED NONLINEAR LAGRANGIAN FOR PSEUDOSCALAR AND SCALAR MESONS. Dondi, P.H.; Eliezer, S. (Department of Applied Mathematics and Theoretical Physics, Cambridge University, Cambridge, England). Phys. Rev. D 8: No. 2, 468-480 (15 July 1973).

We construct a nonlinear Lagrangian to describe the scalar and pseudoscalar mesons such that the chiral $SU(3) \times SU(3)$ symmetry is realized by an octet of Goldstone pseudoscalar mesons while the scalar particles behave neither as parity partners of the pseudoscalar mesons nor as Goldstone bosons in the $SU(3) \times SU(3)$ -symmetry limit. The symmetry-breaking Lagrangian is assumed to transform as the (3,3) + (3,3) representation of the $SU(3) \times SU(3)$ group and contain explicit SU(3)- and SU(2) -violating terms. The transformation properties of the scalar fields together with these breaking terms in the Lagrangian enable our model to have an SU(3) -broken vacuum. We exhibit the masses of the scalar and pseudoscalar particles as well as the decay constants defining PCAC (partial conservation of axial-vector current) and PCVC (partial conservation of vector current) relations in terms of the parameters of the model, and obtain various well-known relationships (including the Glashow-Weinberg sum rules) between the physical quantities. The smoothness assumption is shown to imply approximate $SU(2) \times SU(2)$ symmetry of the Lagrangian with a small SU(3) violation in the vacuum (Gell-Mann-Oakes-Renner model), while an appropriate change in the smoothness assumption leads to approximate SU(3) symmetry of the Lagrangian with an almost $SU(2) \times SU(2)$ -invariant vacuum (Brandt-Preparata model). We calculate the symmetry-breaking parameters of the Lagrangian and vacuum and predict the mass and decay constant of the κ meson. Furthermore, from the width of the decay $\pi N \to \eta\pi$, we obtain the decay widths of all the scalar mesons. Finally, we investigate the nonelectromagnetic SU(2) breaking and find that it gives a major contribution to the kaon mass difference but only a 5% correction to the pion mass difference. The fact that the scalar mesons are needed to get $f_K \neq f_\pi$ and different wave-function renormalization constants for the fields, which enables us to have solutions other than that of Gell-Mann, Oakes, and Renner, demonstrates the importance of the scalar mesons in SU(3) -symmetry breaking effects. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 31135, 31138, 31180, and 31183.

31234 NON-LEPTONIC DECAY IN THE THEORY OF O(4) SYMMETRY. Sato, Shigeo (Rikkyo Univ., Tokyo); Nakamura, S. Progr. Theor. Phys. (Kyoto); 49: No. 4, 1312-1321(Apr 1973).

In the theory of O(4) symmetry, the treatment of the weak decay of hyperons is formulated under the assumption that both of the observed Λ and Σ are the mixture of two states with $\zeta = 0$ and 1, respectively. The Yukawa-type interaction is adopted instead of current-current interaction, and it is assumed that the interaction type of each term is limited to either V or A type. These recipes turn out to be very favorable to the suppression of undesired processes with $|\Delta S| > 1$, and at the same time lead us to a Hamiltonian by which we can reasonably understand the experimental feature of non-leptonic hyperon decays. (auth)

31235 UNIFIED WEAK-ELECTROMAGNETIC GAUGE SCHEMES BASED ON THE THREE-DIMENSIONAL UNITARY GROUP. Schechter, J.; Ueda, Y. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 8: No. 2, 484-490 (15 July 1973).

SU(3) $\times$U(1) and chiral SU(3)$\times$SU(3)$\times$U(1)$\times$U(1) models for the weak and electromagnetic interactions of leptons and hadrons are proposed. The usual quark model for hadrons as well as the usual Cabibbo rotation scheme is assumed. Symmetry-breaking effects due to inequalities in the masses of the gauge bosons are considered. By making a simple choice of the gauge boson masses based on the U-spin subgroup of SU(3), the undesired $|\Delta S|=2$ weak nonleptonic transitions can be completely eliminated and the undesired $|\Delta S|=1$ neutral current semileptonic transitions drastically suppressed. These models can reproduce the ordinary phenomenological weak interaction but are sufficiently flexible to give the possibility of interesting new effects for neutral leptonic and semileptonic processes, as well as to allow the possibility of an over-all arbitrariness in normalization for the effective nonleptonic interaction. Another consequence of the present scheme is the existence of very heavy leptons. A brief discussion of including the strong interactions in a grand unification is also presented. (auth)

31236 SYMMETRY BREAKING IN O(3) GAUGE THEORIES WITH 3-TRIPLET MODELS OF HADRONS. Palmer, W.F. (Department of Physics, The Ohio State University, Columbus; Ohio 43210). Phys. Rev. D 8: No. 2, 504-509 (15 July 1973).

SU(3)- and SU(3)′-symmetry breaking of the zeroth-order mass matrix is studied in a spontaneously broken O(3) gauge-invariant theory of weak and electromagnetic interactions in which Han-Nambu quarks are used to incorporate hadronic weak and electromagnetic processes. The lepton sector is the Georgi-Glashow model. O(3) -symmetry breaking is induced by a single triplet Higgs field. It is shown that various symmetries can be achieved, such as SU(3), SU(2) $\times$ SU(2)′, and parity, only if zeroth-order massless quarks are tolerated. (auth)

Scattering Theory

Refer also to abstracts 31062, 31121, and 31630.

31237 (FTCR-108) RIGOROUS DETERMINATION OF THE SPIN-0 SPIN-½ ELASTIC SCATTERING AMPLITUDES FROM EXPERIMENTAL DATA AND UNITARITY. Alvarez-Estrada, R. F.; Carreras, B. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 41p. (In Spanish). INIS.

The contraction-mapping principle is used to study rigorously the elastic unitarity equations for the scattering of a spin-0 particle by a spin-½ particle when the unpolarized differential cross $d\sigma/d\Omega$ and the polarization P at fixed energy below the first inelastic threshold are known from experiment. It is shown that when $d\sigma/d\Omega$, P and the space where the scattering amplitudes are searched are suitably restricted, the scattering amplitudes exist, are unique and can be found by iterating the unitarity equations. Besides, there are other solutions outside that space associated with well-known ambiguities. It is shown that those ambiguities are solved by measuring the parameters R and A and the sign of the real part of the forward amplitude. (auth)

31238 RELATION BETWEEN REGGE TRAJECTORY INTERCEPTS AND THE ASYMPTOTIC BEHAVIOR OF THE MULTIPLICITY MOMENTS f_k. Abarbanel, H.D.I.; Einhorn, M.B. (National Accelerator Laboratory, Batavia, Illinois, 60510). Phys. Rev. Lett. 30: No. 9, 409-410 (26 Feb 1973).

Assuming that the multiplicity moments $f_k(s)$ formed from the topological cross section $\sigma_n(s)$ or from integrated inclusive correlation functions behave for large s as $f_k(s) \sim c_k$ ln$s$, we discuss a general relation between the c_k and the leading asymptotic behavior of $\sigma_n(s)$. The relation has been given by Harari, but our arguments demonstrate that it is not connected with any hypothesis concerning the dependence of hadronic parameters on some underlying coupling constants. (auth)

31239 VARIATION-ITERATION SOLUTION OF THE VARIABLE-PHASE EQUATION. Tikochinsky, Y.; Koren, U. (Racah Institute of Physics, The Hebrew University of Jerusalem, Jerusalem, Israel). Phys. Rev. A 7: No. 2, 824-825 (Feb 1973).

It is pointed out that the variation-iteration method offers a fast and accurate means for solving the variable-phase equation. The method is especially useful for problems involving many partial waves. (auth)

31240 MATRIX-SHAPE APPROACH TO ELASTIC SCATTERING. Conn, R. (Nuclear Engineering Department, University of Wisconsin, Madison, Wisconsin 53706); Rabitz, H. Phys. Rev. A 7: No. 2, 658-670 (Feb 1973).

The theory and application of the matrix-shape (MS) approach is investigated for elastic scattering. Various aspects of the method, such as the choice of appropriate variables, the choice of basis-set functions as representations of the T-matrix, and the use of a MS fit to the potential matrix that allows $VG^{+}{}_{0}T$-type integrals to be performed analytically, are considered. The method is applied to three-dimensional elastic scattering to ascertain if, on this widely studied problem, the MS approach can in fact produce the essential physics. Numerical calculations are presented to illustrate that reasonable results can be achieved. The numerical results were obtained using two special cases of the method of weighted residuals, which can be used with the MS approach to solve the Lippmann-Schwinger equation for T. The use of the MS approach in conjunction with variational principles is also discussed. (auth)

31241 PARTIAL WAVE ANALYSIS OF DILATATION-INVARIANT RELATIVISTIC S-MATRIX. II. Two-Body Scattering Matrix. Niederle, J.; Tolar, J. (Inst. of Physics, Prague). Czech. J. Phys.; 23: No. 9, 871-883(1973).

Free particle states and S-matrix are defined on carrier spaces of representations of the Weyl group $\tilde{W}$ (Poincaré group extended by dilatations). By using Clebsch-Gordan coefficients of $\tilde{W}$ the extension of the relativistic partial wave analysis of the two-body S-matrix is obtained. Scattering of particles with arbitrary masses and spins is treated and a comparison with relativistic case is discussed. (auth)

31242 INVERSE PROBLEM WITH CONSTRAINTS. Ernst, D.J.; Monahan, J.E.; Shakin, C.M.; Thaler, R.M. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. Lett. 30: No. 19, 929-931 (7 May 1973).

A procedure is presented for constructing a solution to the inverse problem subject to the constraint that the wave functions be prescribed at a finite number of energies. (auth)

31243 ASYMPTOTIC CONSERVATION OF HELICITY FOR VERTEX FUNCTIONS INVOLVING ARBITRARY SPIN. Kim, K.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 2, 555-559 (15 July 1973).

We examine the matrix element of a current with arbitrary number s of four-vector indices between one-particle states of definite helicity. The conservation of the angular momentum in the brick-wall reference frame was used to derive a set of linear relations between the matrix elements. Requiring the helicities of the particles to be conserved asymptotically, we derive a restriction on the spins of the particles. Specifically we show that the helicity cannot be conserved if the larger of the spins of the initial and the final particles are greater than s for massive particles. For the vector current, this means that the matrix element can conserve the helicity asymptotically only between the states of spin less than or equal to unity. (auth)

31244 NONNEGATIVITY OF THE YUKAWA HAMILTONIAN. Hemmer, P.C. (Institute of Theoretical Physics, NTH, Trondheim, Norway). J. Math. Phys. (N.Y.) 14: No. 8, 1140-1140 (Aug 1973).

The Yukawa Hamiltonian $H=-\Delta-r^{-1}e^{-\mu r}$ is shown to be nonnegative for $\mu \geq [1+6 \log 2-9/2 \log 3]^{1/3} \simeq (1.67)^{-1}$. (auth)

31245 ON THE NECESSITY OF NEARLY-BEST-POSSIBLE METHODS FOR ANALYTIC CONTINUATION OF SCATTERING DATA. Miller, K. (Department of Mathematics, University of California, Berkeley, California); Viano, G.A. J. Math. Phys. (N.Y.) 14: No. 8, 1037-1048 (Aug 1973).

In the present paper we discuss some mathematical methods which are nearly-best-possible in order to extract as much as possible information from the numerical analytic continuation of the scattering data. All the questions related to the stability are analyzed; in this sense we explicitly show some cases where the continuity of the solutions on the data is very poor. Finally the error-bounds are extensively explored. (auth)

31246 EQUIVALENT VARIATIONAL FUNCTIONALS IN POTENTIAL SCATTERING. Robinson, P.D. (School of Mathematics, University of Bradford, Bradford, Yorkshire, England). J. Math. Phys.

(N.Y.) 14: No. 8, 1094-1096 (Aug 1973).

The equivalence is established between dual pairs of variational functionals (Kohn type) derived from the differential equation description of potential scattering and other dual pairs of variational functions (Schwinger type) derived from the integral equation description. Apparent differences are resolved by suitable choice of trial vector. The Kohn functional and minus the Schwinger functional are shown to be duals of each other. (auth)

31247 ON ANALYTICAL NONLOCAL POTENTIALS. I. A FORWARD DISPERSION RELATION. Yao, T.H. (University College London, Department of Physics and Astronomy, London WC1, England). J. Math. Phys. (N.Y.) 14: No. 8, 1141-1151 (Aug 1973).

We propose a class of analytic short-ranged nonlocal potentials, and we obtain dispersion relations for the forward scattering amplitude. We use the Fredholm method for the Lippman-Schwinger equation for the scattering solution, and contour rotation in the analytic continuation of the forward scattering amplitude. (auth)

31248 SELECTION OF DYNAMICAL INVARIANT AMPLITUDES AND UNIVERSAL COUPLING CONSTANTS. Coleman, R.A. (Institute of Theoretical Physics, Fack, S-402 20 Göteborg 5, Sweden). Phys. Rev. D 8: No. 2, 398-416 (15 July 1973).

Clesbsch-Gordan coefficients, suitable for reducing in a completly symmetric manner the tensor product of an arbitrary number of "physical" representations of the Poincaré covering group $\bar{P}$, are described in a straightforward fashion. These Clebsch-Gordan coefficients are used to define invariant amplitudes for an arbitrary n-point process and to obtain the partial-wave expansion for the four-point amplitude. A natural definition of crossing leads to the conclusion that the invariant amplitudes introduced are crossing-symmetric. A new dynamical hypothesis is proposed based on the assumption that the above-mentioned crossing-symmetric invariant amplitudes are analytic functions on a certain (3n-10) -dimensional analytic subvariety of the space of complex four-momenta except for those singularities required by extended unitarity. Analyticity in the usual variables, namely, the scalar products of the complex four-momenta, seems to be ruled out. The advantage of the new hypothesis is that all theories constructed from basic three-point vertices would yield renormalized perturbation series by means of the successive pole approximation. Since spinor amplitudes are not employed, another method for introducing coupling constants and determining their dimensions is required. It is proposed that the appropriate universal coupling constants are the partial-wave amplitudes with given orbital angular momentum l and total spin s in a given standard channel for the three-point process. The kinematic factor which defines the dimension of the coupling constants is then $|Q|^l$ where Q^μ is the relative momentum four-vector in that channel. A qualitative examination of a number of common interactions suggests that this hypothesis is reasonable. The dependence of the kinematic factor on the masses of the particles of the three-point vertex is, in general, different from that given by spinor theories. This difference changes the meaning of universality as applied to coupling constants. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

31249 SOME MACROSCOPIC CONSIDERATIONS ON MOTIONS OF ANISOTROPIC SUPERFLUIDS. Anderson, P.W. (Bell Laboratories, Murray Hill, New Jersey, 07974). Phys. Rev. Lett. 30: No. 9, 368-370 (26 Feb 1973).

We give a Herring–Kittel type of discussion of the nuclear–magnetic–resonance phenomena in the presumed anisotropic superfluid phase of liquid ^{3}He. The results agree with Leggett's derivation for high fields in an Anderson–Morel phase but differ fundamentally in other regimes. We observe that all observations so far published suggest that the "A" phase is of Anderson–Morel type (probably L=1), and the "B" phase of Balian–Werthamer type. (auth)

31250 SURFACE STATES OF He^3 IN DILUTE He^3-He^4 SOLUTIONS. Shih, Y.M.; Woo, C. (Department of Physics, Northwestern University, Evanston, Illinois, 60201). Phys. Rev. Lett. 30: No. 11, 478-481 (12 Mar 1973).

We present in support of Andreev's model a fully microscopic calculation of the surface states of He^3 in dilute He^3–He^4 solutions. The surface structure of pure He^4 is first determined. We find a surface tension of 0.36 dyn/cm, in good agreement with experiment. For He^3 there is just one bound surface state, at an energy 1.6°K lower than the chemical potential of He^3 in bulk solutions, centered on the Gibbs surface of the liquid. (auth)

31251 COLLECTIVE EXCITATIONS IN LIQUID HYDROGEN OBSERVED BY COHERENT NEUTRON SCATTERING. Carneiro, K.; Nielsen, M.; McTague, J.P. (Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark). Phys. Rev. Lett. 30: No. 11, 481-485 (12 Mar 1973).

Coherent scattering of neutrons by liquid parahydrogen shows the existence of well-defined collective excitations in this liquid. Qualitative similarity with the scattering from liquid helium is found. Furthermore, in the range of observed wave vectors, $0.7\ Å^{-1} \leq \kappa \leq 3.1\ Å^{-1}$, extending from the first through the third Brillouin zones in the solid, $S(\kappa,\omega)$ is remarkably similar to the scattering law expected from a polycrystal. For $\kappa \leq 2.3\ Å^{-1}$ the observed spectra satisfy the one-phonon sum rule with mean square displacement $\langle u^2 \rangle = 1.0\ Å^2$. (auth)

31252 TEMPERATURE DEPENDENCE OF THE ACCOMMODATION COEFFICIENT OF LIQUID-HELIUM FILM. Wang, T. G.; Elleman, D. D.; Olli, E. E.; Saffren, M. M. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, 91103). Phys. Rev. Lett. 30: No. 11, 485-487(12 Mar 1973).

We have determined the accommodation coefficient γ of a helium film from 1.15 to 4°K by measuring the time constant of a rotating superconducting Nb sphere levitated in vapor and covered with a saturated helium film. The conventional assumption of the phenomenological theory of superfluidity, that the order parameter ψ vanishes at the free surface of helium II, implies that γ is unity and independent of temperature. We find that γ is nearly unity above the λ point, suffers an abrupt drop close to T_λ, and gradually levels off to the value of $\simeq$0.8 at lower temperatures. (auth)

31253 CRITICAL FIRST-SOUND ABSORPTION IN LIQUID ^{4}He NEAR THE LAMBDA-TRANSITION. Kretzen, H. H. (Univ., Hanover). J. Low Temp. Phys.; 12: No. 3/4, 413-418(Aug 1973).

The mode–mode coupling expression for the critical first-sound damping parameter D_1 is renormalized using scaling and consistency arguments so as to avoid factorization of fluctuations and the uncertainty about the static susceptibility of the order parameter. The function $D(\omega, T - T_\lambda)$ shows the high-frequency behavior obtained by Kawasaki, supporting the idea of "frequency scaling", and it provides a quantitative estimate in reasonable agreement with experiment. (auth)

31254 KAPITZA RESISTANCE BETWEEN THE TRANSITION METALS Fe, Co, AND Ni AND SUPERFLUID HELIUM. Cheeke, J. D. N.; Hebral, B.; Richard, J. (CNRS, Grenoble, France). J. Low Temp. Phys.; 12: No. 3/4 359-373(Aug 1973).

Measurements of the Kapitza resistance R_K between Fe, Co, and Ni and superfluid helium in the range 1 to 2 K are presented. The results are in strong numerical disagreement with the Khalatnikov model. It is also found that R_K depends hardly at all upon the state of mechanical deformation of the surface, in sharp disagreement with the previous work of Wey–Yen on nickel. The results are internally consistent and fit into the general pattern of available published work on other materials. (auth)

31255 SOUND VELOCITY IN LIQUID ^{4}He UNDER PRESSURE. Roach, P. R.; Ketterson, J. B.; Abraham, B. M.; Kuchnir, M. (Argonne National Lab., IL). J. Low Temp. Phys.; 12: No. 3/4, 375-385(Aug 1973).

The temperature dependence of the sound velocity in liquid ^{4}He was measured at pressures from the vapor pressure to near the solidification pressure. The data were obtained at frequencies from 12 to 105 MHz and covered the temperature range from below 0.1 to nearly 1.0 K. The velocity data at high pressures do not show any anomaly that can be associated with a distinct shoulder found earlier in the sound attenuation. As observed previously at the vapor pressure, the frequency dependence of the velocity data undergoes an inversion at low temperatures; this unexpected behavior is in agreement with recent theoretical treatments. (auth)

31256 FEW-PHONON STRUCTURE FUNCTIONS FOR LIQUID HELIUM II. Aranoff, S. (Univ. of the Negev, Beer Sheva, Israel). J. Low Temp. Phys.; 12: No. 3/4, 285-307(Aug 1973).

A semiphenomenological method is formulated for calculating the Fourier transforms of the few-body distribution functions—the few-phonon liquid structure functions $S_s(q_1, \ldots, q_{s-1})$—on the basis of a functional Ansatz independent of a superposition approximation. The two-phonon function $S_2(q) = S(q)$ is calculated and compared with the experimental S(q) to determine the parameters of the functional Ansatz. The procedure is to write S_s in second-quantized form, to transfer from particle operators a_k to operators α_k, and then to take expectation values with respect to the ground state $|0\rangle$ of the α_k's. The transformation is, for $k \neq 0$, $a_k = (1 + v_k^2)^{1/2}\ \alpha_k + v_k^2\ \alpha_{-k}^+$. For k = 0, $a_0^+ a_0|0\rangle$ is written in terms of the other a_k's as effectively the most general possible expression. This expression is nonlinear and involves arbitrary parametric functions subject to the restrictions that $\langle 0|a_0^+ a_0|0\rangle = N_0$, and that the S_s have the proper physical properties. The s-body function S_s is then expressed as a functional of v_k, and s − 1 parametric functions $c_2, \ldots, c_{s-1}$ arising from the expression for $a_0^+ a_0|0\rangle$. The functions $c_3, c_4, \ldots$, contribute only for small q. A simple algebraic expression for v_k, containing only a few parameters, is found which yields agreement with experiment for S(q) to within the 10% calculational error. The relative number of particles in the zero-momentum state n_0, calculated as a consistency check, turns out to be equal to 0.2. Having determined v_k and c_2, S_3 can then be evaluated in a straight forward manner. S_3 is explicitly displayed as a functional of v_k, c_2, and c_3. It is shown that $c_3(k,k')$ can be chosen so that $S_3(s,p)$ has the correct known behavior for small s. (auth)

31257 ISOTHERMAL FLOW OF SUPERFLUID HELIUM THROUGH NARROW CHANNELS. Talmi, A.; Landau, J. (Technion-Israel Inst. of Tech., Haifa). J. Low Temp. Phys.; 12: No. 3/4, 275-283(Aug 1973).

The differential pressure across channels was measured as a function of the flow rate of superfluid helium for two different systems of long narrow channels in the temperature range 1.3 to 2.2 K. The systems were a wire-filled capillary with a 10-μm gap and a rod of porous Vycor glass with an average pore diameter of ~60 Å. A large hysteresis is observed for Vycor, while for the capillary, in the limit of high temperatures and large velocities, the flow characteristics tend to those of a normal fluid with the same viscosity. (auth)

31258 DAMPING OF TRANSVERSE WAVES IN ROTATING HELIUM. Tkachenko, V. K. (Inst. of Solid State Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 434-435 (5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 617-618(5 Jun 1973).

The damping of transverse waves in rotating helium is calculated with allowance of the joint oscillations of the superfluid and normal components. It is found that at an oscillation period ~1 min and an angular velocity of several radians the damping is weak enough and the transverse waves can be experimentally observed. (auth)

31259 SPECIFIC HEAT OF LIQUID ^{3}He IN SINTERED COPPER BELOW 3 mK. Dundon, J. M.; Stolfa, D. L.; Goodkind, J. M. (Univ. of California, San Diego, La Jolla). Phys. Rev. Lett.; 30: No. 18, 843-846(30 Apr 1973).

A nuclear cooling system consisting of copper wire was connected to a copper container inside of which a copper powder had been compressed and sintered. The heat capacity of the system without ^{3}He in the container was subtracted from the heat capacity with ^{3}He at pressures ranging from 0 to 29 atm. The difference shows a peak

at 1.5 mK which decreases in magnitude as the pressure is reduced and a broad shoulder extending up to about 3 mK which is present at all pressures. (auth)

3126C PRESSURE DEPENDENCE OF CHARGE CARRIER MOBILITIES IN SUPERFLUID HELIUM. Ostermeier, R.M. (Department of Physics and the James Franck Institute, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. A 8: No. 1, 514-529 (July 1973).

Accurate measurements were made of the mobility of positive and negative charge carriers in He^4, at pressures up to the melting pressure and temperatures in the range $0.27 < T < 1.0$ °K. The data are analyzed in terms of the scattering of phonons and rotons by the charge carriers. The phonon-dominated mobility of the negatives agrees well with existing theories, and analysis of these results provides a new determination of the electron-bubble radius as a function of pressure. The phonon-scattering term for positives is calculated from the electrostriction model, and is in good agreement with the experimental results. Roton-limited mobilities are obtained by subtracting the known phonon contributions. One may express the results in the form $(e/\mu)_\pm = f_\pm(P,T)e^{-\Delta(P,T)/kT}$, where Δ (P,T) is the pressure- and temperature-dependent energy gap derived from neutron-scattering experiments. The measured pressure and temperature dependences of the prefactors $f_\pm(P,T)$ are discussed in light of recent theories for the scattering of rotons by the charge carriers. (auth)

31261 THERMODYNAMICS AND EXPERIMENTAL TESTS OF STATIC SCALING AND UNIVERSALITY NEAR THE SUPERFLUID TRANSITION IN HE^4 UNDER PRESSURE. Ahlers, G. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. A 8: No. 1, 530-568 (July 1973).

The heat capacity at constant volume C_v and the pressure coefficient $(\partial P/\partial T)_v$ were measured near the superfluid transition on six isochores. This work also yielded new results for the derivatives $(\partial V/\partial T)_\lambda$ and $(\partial S/\partial T)_\lambda$ along the λ line (V is the molar volume and S the entropy). An essentially complete and detailed description of the thermodynamics of the superfluid transition at all pressures is provided by the data. In particular, the results were used to derive the heat capacity at constant pressure C_p, the compressibility κ, the thermal expansion coefficient α, the ratio $\gamma \equiv C_p/C_v$, and the isentropic sound velocity u, along isobars. The heat capacity C_p was examined carefully for its asymptotic behavior near T_λ. Although several interpretations of the data are possible with different assumptions about singular correction terms, it is clear that the exponents α and α' are near zero, and that the ratio A/A' of the amplitude above T_λ to the amplitude below T_λ is greater than unity and pressure dependent. The results are compared with the predictions of scaling and universality. The assumption of pure-power-law singularity in C_p results in $\alpha+\alpha'$ at some pressures, and thus yields disagreement with scaling. The inclusion of singular higher-order contributions to C_p in the analysis increases the uncertainty in the exponents derived from the data, and the prediction $\alpha=\alpha'$ of scaling falls within these larger uncertainties. The amplitude ratio remains greater than unity, and thus only nonzero exponents are consistent with scaling. The pressure dependence of A/A' is not removed by the type of correction terms considered in the analysis, and is contrary to universality. When recent calculations for the exponent of the correction terms are assumed valid, then only a negative leading exponent is permitted by the data. This implies a finite C_p at T_λ. If $\alpha=\alpha'<0$, then the data permit a continuous C_p at T_λ and at all pressures only if, contrary to universality, α and α' depend upon the pressure. (auth)

Superconductivity

Refer also to abstracts 30421, 32083, and 32084.

31262 (AD-761413) DEFORMATION-INDUCED ANISOTROPY OF THE CRITICAL CURRENT IN SINGLE CRYSTAL NIOBIUM. Good, J. A.; Kramer, E. J. (Cornell Univ., Ithaca, N. Y. Materials Science Center). 17 Nov 1969. 64p. (MSC-1279; NYO-4060-2). NTIS.

Anisotropy of the critical current in a (110) niobium single crystal of very high purity is observed to result from tensile deformation. The critical current exhibits local maxima when the magnetic field is directed along the (1,-1,0) and (001) directions. The height of the (1,-1,0) maximum increases with respect to the height of (001) maximum as the magnetic field is decreased. The (001) maximum is sensitive to the condition of the sample surface and exhibits rectification. There is a contribution to the anisotropy of the as-deformed crystal caused by anisotropic surface roughness, which can be removed by chemical polishing. The effect of the interaction at the surface is thought to be magnified by the decrease in the flux line lattice shear modulus C66 in that region. (GRA)

31263 (BNL-18057) NEUTRON SCATTERING STUDIES OF SOFT MODE DYNAMICS. Axe, J. D.; Shapiro, S. M.; Shirane, G.; Riste, T. (Brookhaven National Lab., Upton, N. Y.). 1973. 15p. (CONF-730464-1). Dep. NTIS $3.00.

From NATO Advance Study Institute Conference; Ustaoset, Norway (24 Apr 1973).

The critical behavior of $SrTiO_3$ near the 105°K structural phase transformation was reported previously as studied by neutron scattering. It was observed that in addition to the expected condensing soft mode phonon side bands that there was a very narrow control component. Progress on the neutron scattering work of the last two years on the "central mode problem" is reported. β-tungsten superconductors are discussed in general. Results are given for $SrTiO_3$, $KMnF_3$, and $LaAlO_3$. (MHR)

31264 (FRNC-TH-401) STUDY OF THE MEISSNER EFFECT IN INHOMOGENEOUS AND METASTABLE SUPERCONDUCTORS. Valette, C. (Paris-11 Univ., 91 - Orsay (France)). 1971. 84p. (In French). Dep. NTIS (U.S. Sales Only) $6.25.

Thesis.

The Meissner effect induced in an inhomogeneous superconductor (normal metal N under the critical temperature) by the proximity effect of a superconductor S in good electric contact with N was studied. The amplitude of the Meissner effect depends on the temperature, resistivity of the normal metal, and its electron-electron interaction. The study of the Meissner effect enabled the measurement of this interaction for two metals (Ag and Cu). The interaction was shown to be attractive, both metals should then become superconducting at low temperatures. The case of metastable Type-I superconductors was also examined. In this type of superconductor either the Meissner effect still exists above the critical field for which the normal and superconducting phases have the same energy (superheated state) or, in the contrary, the normal state exists below this field value (delayed condensation). The intrinsic limit for the existence of such metastable states can be observed with either pure metals or alloys; a measured value is such obtained for the Ginzburg-Landau parameter in superconductors of the first kind. The metastable character of these states is demonstrated by the possibility of interruption of the superheated state by β^- irradiation (analog with the bubble chamber phenomena). (auth)

31265 (JUL-958-FF) FLUX LINES IN TYPE II SUPERCONDUCTORS. Ullmaier, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung). Jun 1973. 188p. (In German). Dep. NTIS (U.S. Sales Only) $11.50.

The state-of-the-art of flux lines in type-II superconductors is presented. (GE)

31266 (ORNL-4870, pp 23-25) SUPERCONDUCTING MATERIALS. Koch, C. C. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Research is reported on the effects of metallurgical variables on the properties of superconducting materials. Critical current densities were measured in sputter-deposited Nb-Al-Ge. (DLC)

31267 ULTRASONIC STUDIES OF THE ELECTRONIC STRUCTURE OF HEXAGONAL METAL CRYSTALS. Part 2. Superconducting State in Zinc and Cadmium. Dobbs, E. R.; Lea, M. J.; Peck, D. R. (Univ. of Lancaster, Eng.). Proc. Roy. Soc. (London), Ser. A; 334: No. 1598, 379-396(18 Sep 1973).

Measurements have been made of the temperature dependence of the attenuation of longitudinal ultrasound in the superconducting states of pure zinc and cadmium for propagation along the $\langle 0001 \rangle$, $\langle 10\bar{1}0 \rangle$ and $\langle 11\bar{2}0 \rangle$ directions, at frequencies from 40 to 160 MHz. This temperature dependence has been interpreted in terms of an energy gap parameter $A = 2\Delta(0)/kT_c$. In zinc, for $T < \frac{1}{2}T_c$, A was found to be 3.41 ± 0.1, 3.79 ± 0.1 and 3.64 ± 0.1 for the $\langle 0001 \rangle$, $\langle 10\bar{1}0 \rangle$ and $\langle 12\bar{2}0 \rangle$ directions respectively. The corresponding values for cadmium were 3.29 ± 0.1, 2.80 ± 0.1 and 3.87 ± 0.1. A simple model proposed by Hays (Phys. Rev.; B1: 3631-3636 (1970)) for the distribution of the energy gaps on the Fermi surface of zinc does not explain these results, and a more realistic model has been proposed. The main features of the proposed energy-gap distributions in zinc and cadmium are that the electrons on the third band lens have larger energy gaps than those on the second band monster, over which there is a large and complicated variation. (auth)

31268 PARAMAGNETIC SUSCEPTIBILITY AND TRANSITION AT LOW TEMPERATURE. 2. Superconductivity and Magnetic Properties of A-15 Compounds. Kodess, B. N. (Ural'skij Politekhnicheskij Inst., Sverdlovsk, USSR). Solid State Commun.; 13: No. 5, 527-530(1 Sep 1973). (In French).

A report is presented on the "concentration-temperature" dependences of the paramagnetic susceptibilities of A-15 compounds with high transition temperatures T_c in the superconducting state.

The applicability of the calculated results of the band structure of V_3X for Nb_3X compounds was confirmed and proposed as a progressive method. The elimination of nonstoichiometry seems greatly to increase T_c. (auth)

31269 PARAMAGNETIC SUSCEPTIBILITY AND TRANSITION AT LOW TEMPERATURE. 1. Influence of the Second Intransitive Component in Vanadium-based Compounds. Kodess, B. N. (Ural'skij Politekhnicheskij Inst., Sverdlovsk, USSR). Solid State Commun.; 13: No. 5, 523-525(1 Sep 1973). (In French).

The data of instability of the crystal lattice (anomalous lowering of the intensity of Bragg reflections) have been considered simultaneously with anomalous temperature variation of the paramagnetic susceptibility χ of the isoelectronic quasi-binary system $V_3(Si-Ge)$. The values χ, $\chi(T)$ and T_c increase monotonically from V_3Ge(a = 4.78Å) to V_3Si(a = 4.72Å). It is suggested that the distances between the different atoms may be fundamental parameters of the electronic structure in superconducting compounds A-15. (auth)

31270 EFFECTS OF STOICHIOMETRY ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF U_8Fe AND THE URANIUM ISOTOPE EFFECT. White, R. W.; Lindsay, J. D. G.; Fowler, R. D. (Los Alamos Scientific Lab., NM). Solid State Commun.; 13: No. 5, 531-532(1 Sep 1973).

Determination of the uranium isotope effect on the superconducting transition temperature of U_8Fe led to studies of the effects of stoichiometry on transition temperature. At the nominal composition $U_{8.1}Fe$ samples were made from five batches of ^{235}U and five batches of ^{238}U, heat-treated, and their transition temperatures measured. Attributing the isotopic shift in T_c to the uranium masses alone the isotope effect is calculated to be $T_c \propto M^{-0.37\pm0.01}$. (auth)

31271 LOCAL MODEL OF NONIDEAL TYPE-II SUPERCONDUCTORS. 2. Flow Conductivity. Msatsunaga, S. (Japan Atomic Energy Research Inst., Tokai). Jap. J. Appl. Phys.; 11: No. 6, 893-903(Jun 1972).

The flow conductivity of non-ideal type-II superconductors with pinning force is presented using the local model, in which the local field of fluxoid is given by modifying the general solution of the London equation. The local field is deformed due to the motion of fluxoid. The amplitude of the deformation in ideal superconductors without pinning force is derived by comparing the flow conductivity calculated by the local model with that by the time-dependent Ginzburg–Landau theory. The flow conductivity of non-ideal superconductors is calculated by superposing the deformation due to the motion of fluxoid on that due to the pinning force. As the result of the superposition of both the deformations, the flow conductivity of non-ideal superconductors becomes smaller than that of ideal superconductors. Further, varieties of J_c-V characteristics in the non-ideal superconductors are explained by the growth of the deformation. (auth)

31272 SUPERCONDUCTIVITY OF COPPER CONTAINING SMALL AMOUNTS OF NIOBIUM. Tsuei, C. C.; Newkirk, L. R. (California Inst. of Tech., Pasadena). J. Mater. Sci.; 8: No. 9, 1307-1304(Sep 1973).

Superconductivity of copper containing small amounts of niobium has been investigated by measuring the electrical resistivity, superconducting volume fraction and by metallographic studies. Small amounts of niobium added to copper have a drastic effect on the low temperature resistivity of the alloys. The annealed alloy $Cu_{99.5}Nb_{0.5}$ shows zero resistance at a current density of 200 A cm^{-2} below 3 K. The estimated superconducting volume fraction of this alloy at 2 K is about fifty times the physical volume fraction of the Nb in the alloy. When more Nb is added these effects unexpectedly become much smaller than those observed in the dilute alloys, (<1.5 at. % Nb). Metallographic results indicate that in all the Cu–Nb alloys studied there are two distinct types of Nb particles in the Cu matrix. The large particles (average size ~10 μm) randomly distributed in the alloy are probably formed at high temperature when the bulk of the alloy is still in the liquid state. The small Nb particles (size $\ll$1 μm, interparticle distances <0.2 μm) probably form through a solid state precipitation. It has been found that the large precipitates are more abundant in the alloy containing more than 1.5 at. % Nb, than in alloys containing less than 1.5 at. % Nb. The observed superconducting properties of alloys $Cu_{99.8}Nb_{0.2}$ and $Cu_{99.5}Nb_{0.5}$ have been attributed to the proximity effect of the small Nb particles whose interparticle distances are compatible with the coherence length in the Cu matrix. The very wide superconducting transition shown in both the resistivity and the inductance measurements suggested a distribution in the Nb particle sizes as well as in the interparticle distances. (auth)

31273 FLUCTUATION-INDUCED DIAMAGNETISM IN DIRTY SUPERCONDUCTORS. Maki, K. (Department of Physics, University of California, Los Angeles, California, 90024). Phys. Rev. Lett. 30: No. 14, 648-652 (2 Apr 1973).

An explicit evaluation is made of the fluctuation-induced diamagnetism from zero-point fluctuations, which have been neglected in a previous calculation by Maki and Takayama. It is shown that in fact this contribution has another scaling field $\sim\phi_0/l^2$, as calculated previously by Lee and Payne and Kurkijärvi, Ambegaokar, and Eilenberger. However, this term gives rise to an almost constant susceptibility (of the same order as Landau diamagnetism) in the field region of experimental interest [i.e., $H \sim H_{c2}(O)$, the upper field at T = 0 K]. (auth)

31274 OBSERVATION OF INTERMEDIATE QUANTUM-RESISTANCE STATES OF TYPE-I SUPERCONDUCTING FILMS IN PARALLEL MAGNETIC FIELDS. Chen, J.T.; Hayler, L.G.; Kim, Y.W. (Department of Physics, Wayne State University, Detroit, Michigan, 48202). Phys. Rev. Lett. 30: No. 14, 645-648 (2 Apr 1973).

We have found several new conducting states of constant and quantized resistances in a superconducting Pb film in parallel magnetic fields between H_{c2} and H_{c3}. These states can be explained qualitatively as due to the conduction of coherent quasiparticles in the normal lamina penetrated by the magnetic field. (auth)

31275 QUASIPARTICLE PHENOMENOLOGY OR THERMODYNAMICS OF STRONG-COUPLING SUPERCONDUCTORS. Padamsee, H.; Neighbor, J. E.; Shiffman, C. A. (Northeastern Univ., Boston). J. Low Temp. Phys.; 12: No. 3/4, 387-411 (Aug 1973).

It is shown that reduced critical fields, entropies, and specific heats of superconductors, regardless of "coupling-strength," can be fitted essentially within experimental errors by curves appropriate to a system of independent fermion quasiparticles. The analysis proceeds from the formula for the entropy of a system of independent fermions $S = -k_B \Sigma[f \ln f + (1-f) \ln (1-f)]$, where we take the quasiparticle spectrum to be the same as in the BCS (weak-coupling) theory $E_k^2 = (\epsilon_k^2 + \Delta^2)$. The temperature dependence of the energy gap is also taken to be the same as in the BCS theory, the only adjustable parameter being the gap ratio $\Delta(0)/k_B T_c$. The necessary values of this ratio are found to be in reasonable agreement with the experimental values deduced from electron tunneling and infrared absorption. Some speculations are offered for the paradoxical success of this simple model, based on analogies with the effects of strong coupling in the normal state. (auth)

31276 TRANSVERSE CRITICAL FIELDS OF SMALL SUPERCONDUCTING ELLIPTICAL CYLINDERS. Meissner, H. (Stevens Inst. of Tech., Hoboken, NJ). J. Low Temp. Phys.; 12: No. 3/4, 263-273(Aug 1973).

Using the Ginzburg–Landau theory the transverse critical field of small ($a \ll \xi_0$, $b \ll \xi_0$) cylinders of elliptical cross section has been calculated for an arbitrary angle between the field and the axes of the ellipse. The criterion for second-order phase transitions has been found. While the equations readily reduce to the case of the circular cylinder, they do not reduce to the case of the flat film. The reasons for this are discussed. (auth)

31277 THEORY OF THE PEIERLS SOFT-MODE INDUCED SUPERCONDUCTING INSTABILITY OF A LINEAR CHAIN CONDUCTOR. Rice, M. J.; Straessler, S. (Brown, Boveri and Co., Ltd., Baden, Switzerland). Solid State Commun.; 13: No. 6, 697-700(15 Sep 1973).

It is found that the Peierls soft-phonon mode mechanism does not produce a high-temperature superconducting instability in a quasi-one-dimensional band conductor. (auth)

31278 SUPERCONDUCTING PROPERTIES OF ALLOYS OF THE VANADIUM–NIOBIUM–CHROMIUM SYSTEM. Sirota, N. N.; Fedotov, A. K. (Inst. of Solid-State Physics and Semiconductors, Minsk). Dokl. Akad. Nauk BSSR; 17: No. 6, 497-500(Jun 1973). (In Russian).

The superconducting properties of alloys of the ternary system V–Nb–Cr were investigated. It was shown that the temperature of the superconducting transition T_c of the majority of the alloys is reduced by increase of the Cr. Only in the concentration range of Nb from 50 to 80 at.% does the increase of the concentration of Cr from 8.5 to 9.5 at.% lead to increase of T_c. The critical fields H_{C_2} (O) of the V–Nb alloy and the ternary cross section, parallel to the V–Nb side of the concentration triangle, pass through the maximum in the vicinity of 30 to 35 at.% Nb. The temperature dependence of H_{C_2} (T) approximates the square law. On the basis of the measured values of T_c, H_{C_2} (O), and the residual resistance ρ_0, the microscopic characteristics of some alloys of the V–Nb–Cr system were calculated in the solution region. (tr-auth)

31279 QUANTIZED FLUCTUATIONS IN THE JOSEPHSON OSCILLATIONS OF A SHUNTED SUPERCONDUCTING POINT

CONTACT. Sandell, R.D.; Wikswo, J.P. Jr.; Pickler, J.M.; Deaver, B.S. Jr. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). J. Appl. Phys. 44: No. 7, 3312-3318 (July 1973).

By detecting the oscillation of a tuned circuit resonant at frequency ν_0 coupled to a shunted superconducting point contact we have observed oscillations not only at the Josephson voltage $V=\Phi_0\nu_0$, where Φ_0 is the flux quantum, but also at voltages $V_n=g_n(T)\ \Phi_0\nu_0$, where $g_n(T)$ is a continuous monotonic function of temperature. For most temperatures $g_n(T) = N(T)/n$, where N and n are integers, however there are ranges of temperature over which $g_1(T)$ varies rapidly through nonintegral values and the voltages V_n are not harmonically related. The level of oscillation of the tuned circuit was used to measure the power spectrum of the voltage waveform at the point contact and the linewidths were found to be oscillatory functions of temperature with minima when $V_1=N\Phi_0\nu_0$ and maxima when $V_1=(N+1/2)\ \Phi_0\nu_0$. The Josephson oscillation of the shunted point contact consists of pulses of N flux quanta ($N\Phi_0$) crossing the point contact at a repetition frequency ν_0. The temperature dependencies are interpreted in terms of fluctuations in N. The relationship between these results and some temperature dependent features observed on the I–V curves of point contacts and some implications for noise thermometry are discussed. (auth)

31280 FIELD, ANGULAR, AND DEFECT DEPENDENCE OF THE CRITICAL CURRENT OF Nb_3SN FOR $T \leq 4.2$ °K. Cullen, G.W.; Cody, G.D. (RCA Laboratories, Princeton, New Jersey 08540). J. Appl. Phys. 44: No. 6, 2838-2842 (June 1973).

Measurements are reported for the critical current of chemically transported Nb_3Sn as a function of applied field from 0 to 104 kG. The angular variation of the critical current at constant field is examined in detail. Data are given for the temperature dependence of the transverse and longitudinal critical current as well as the effect of neutron damage on homogeneous low-α specimens of Nb_3Sn. (auth)

31281 LONGITUDINAL AND TRANSVERSE CRITICAL CURRENTS OF CHEMICALLY DEPOSITED NB_3SN IN THE TEMPERATURE RANGE 14.5–17.5°K. Cody, G.D.; Cullen, G.W. (RCA Laboratories, Princeton, New Jersey 08540). J. Appl. Phys. 44: No. 6, 2843-2846 (June 1973).

Measurements are reported on the longitudinal and transverse critical currents of chemically deposited Nb_3Sn at temperatures close to T_c. Significant and systematic deviations are observed between these measurements and a simple flux pinning model of volume currents. The analysis suggests that surface supercurrents, which depend on the fundamental superconducting properties of the material, dominate the superconductivity properties reported here. (auth)

Equipment and Devices

Refer also to abstract 31020.

31282 SUPERCONDUCTING MAGNETIC SYSTEMS MADE OF RIBBON Nb_3Sn. Bashilov, V. A.; Zhimerin, D. G.; Kunakov, Ya. N. Dokl. Akad. Nauk SSSR; 210: No. 3, 570-572(21 May 1973). (In Russian).

A superconducting film material made of Nb_3Sn covered with 30 to 80 microns of copper has been produced. Values of the critical current of the superconducting film material in a transverse magnetic field at 1 mm width are 37 a/mm at 30 koe, 22 a/mm at 50 koe, 19 a/mm at 60 koe, and 14 a/mm at 80 koe. Four superconducting solenoids of different sizes were constructed from the superconducting ribbon material. Solenoids S1, S2 and S3 are single-section solenoids of the usual type with a stainless steel conducting central tube having internal diameters of 33, 200 and 33 mm respectively. Solenoids S1 and S2 are wound with busbar material 20 mm thick, and solenoid S3 with busbar material 10 mm thick. Solenoid S4H is a horizontal solenoid. These solenoids were tested a number of times, and returned to the normal state. The current was introduced at a rate of ~5 a/min. For solenoids S1 and S3 a measuring rod with ferromagnetic concentrators was made. The diameter of the concentrators was 32.5 mm; the gap between the concentrators in the rod was 3 mm. A Hall meter was placed in the gap between concentrators to measure the field. Tests of the solenoids with the concentrators showed an increase in magnetic field by 20 koe. The magnetic field was 127 koe for the S1 solenoid and 142 koe for the S3 solenoid. The measuring rod is intended to measure the critical current of superconducting materials. (SJR)

31283 IMPROVED RESISTIVE ENVELOPE FOR A MULTIFILAMENT SUPERCONDUCTOR WIRE. McInturff, A. D.; Abbatiello, F. J. (to United States Atomic Energy Commission). U. S. Patent 3,743,986. 3 Jul 1973. Filed date 8 Feb 1972. 10p.

An improved method for making superconductors and/or improving their superconducting characteristics is described in which an insulating or resistive envelope forming a sheath having a resistance higher than the superconductors is formed around a multifilamentary matrix stabilized superconductor wire. In one example, a tin-bronze layer is formed around multi-filamentary, matrix stabilized superconductor wires, and the tinbronze layer is converted, at least in part, into an insulator. Also, an indium-thalium heat sink is provided. Additionally, multifilamentary superconductor wires are provided having a copper matrix into which titanium is diffused to leave a more resistive matrix around the Nb-Ti filaments. (auth)

31284 SUPERCONDUCTIVE QUANTUM INTERFERENCE DEVICE HAVING TWO CAVITIES ISOLATED BY A SUPERCONDUCTIVE WEAK LINK. Zimmerman, J. E. US Patent 3,758,854. 11 Sep 1973. Filed date 12 Mar 1971. 14p.

A symmetric superconductive quantum interference device (SQUID) for use in magnetic field, or radio frequency energy, sensing systems is described. The symmetric SQUID comprises a solid niobium cylinder with a dumbbell shaped hole formed longitudinally therethrough. A pair of niobium screws, one having a flat end and the other having a pointed end, are positioned in the cylinder normal to its longitudinal axis so as to contact and form a weak superconductive link in the narrow portion of the dumbbell shaped hole. The symmetric SQUID exhibits the quantum interference effect in response to a difference in magnetic field strength between its two holes (i.e., the two circular portions of the dumbbell shaped hole). Thus the device will respond directly to a magnetic field gradient, but not to a uniform magnetic field. Response to a uniform magnetic field can be achieved by inductively coupling a flux transformer to one hole of the device, so that in the presence of an applied field, flux shifts from one hole of the device to the other. Magnetic field gradients can be sensed by inductively coupling a gradient-sensitive flux transformer to one hole of the SQUID. The gradient sensitive flux transformer may comprise a pair of superconductive loops each formed by a thin niobium sheet wrapped around a quartz tube. In another embodiment of the invention, suitable for making sensitive temperature measurements, cerous magnesium nitrate (CMN) powder is inserted into one hole of the symmetric SQUID. The SQUID is then cooled to its superconductive state in the presence of a magnetic field and then the field is removed. A change in temperature causes the susceptance of the CMN powder to change, thereby shifting magnetic flux lines from one hole of the device to the other. This shifting of flux causes a change in the impedance of the SQUID. This change can be measured to ascertain the temperature change. (auth)

31285 SUPERCONDUCTIVE CIRCUITRY USING JOSEPHSON TUNNELING DEVICES. Anacker, W.; Matisoo, J. (to International Business Machines Corp.). US Patent 3,758,795. 11 Sep 1973. Filed date 30 Jun 1972. 10p.

Superconductive circuitry is described using a first Josephson tunneling device connected to a transmission line having a termination such that no reflections result when the Josephson tunneling diode switches between two stable voltage states, in accordance with applied input signals. Means are provided for producing the input signals to switch the first Josephson tunneling device and further Josephson tunneling devices are provided whose voltage state depends on the current pulse delivered to the transmission line when the first Josephson tunneling device switches from a first voltage state to a second voltage state. Logic circuitry is shown using this structure as well as fan-in and fan-out Josephson tunneling device circuits. (auth)

31286 FREQUENCY CONVERSION ON A JOSEPHSON JUNCTION. Nad, F. Ya. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 11, 1892-1896(Nov 1972).

Translated from Radiotekh. Elektron.; 17: No. 11, 2360-2364 (Nov 1972).

The properties of weakly connected superconductors (Josephson junctions) with quasi-particle currents are analyzed in terms of suitability as elements of receivers acting as frequency converters. Expressions are devised for currents and voltages at the frequency of the external signal and at combination frequencies in the individual Josephson junction in the presence of voltage, assuming irradiation. On the basis of these data the impedances were computed for a Josephson junction acting as a nonlinear frequency converter. The conditions were determined for the onset of regeneration and the conversion coefficient was computed for small and large voltages on the junction. The bandwidth and the noise temperature of the system are evaluated. (auth)

31287 DAMPING OF ELECTROMAGNETIC WAVES IN SMOOTH, SUPERCONDUCTIVE WAVEGUIDES. Dibenko, A. N.; Shiyan, V. P. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 11, 1959-1961(Nov 1972).

Translated from Radiotekh. Elektron.; 17: No. 11, 2438-2439 (Nov 1972).

The damping of electromagnetic waves in smooth superconductive waveguides has certain distinctive properties that are connected with the more complex relationship of the surface impedance with frequency and temperature and thus point out the fact that the optimal dimensions of superconductive waveguides may be different from those of ordinary waveguides. In the case of superconductive walls, the microwave field penetrates into the superconductor at a very slight depth and one may therefore use these conditions to determine the losses in the superconductive waveguides. The second interesting property of the superconductive waveguides in this range of frequencies and temperatures appears to be that for H_{0_n}-type waves, the damping coefficient does not decrease with the increase of ν, but when $\nu \to \infty$, it defines the limit $\alpha^{(H_{0_n})} \sim C_2$. It is shown that the dimensions of waveguides, though optimal at normal state, remain non-optimal during the transfer of metal into superconductive state. The increase is inessential for H-waves but significant for E-waves. It is noted that results may be extended to coaxial superconductive waveguides. (MHR)

31288 EDDY CURRENTS IN FLAT METAL-FILLED SUPERCONDUCTING BRAIDS. Morgan, G.H. (Brookhaven National Laboratory, Upton, New York, 11973). J. Appl. Phys. 44: No. 7, 3319-3322 (July 1973).

Flat braids partially soldered together with a soft nonsuperconducting alloy have superior electrical stability and mechanical properties as compared to braids made from fully insulated superconducting wires. Eddy currents induced by a changing field, however, may cause undesirable field shape changes and power loss in magnets. An analysis of these eddy currents for the case of constant rate of change of field is presented, and comparisons made with observed field distortions or power loss in two magnets. (auth)

31289 POINT-CONTACT TUNNELING DEVICE. Moore, S.E.; Meincke, P.P.M. (Physics Department, Erindale College, University of Toronto, Mississauga, Ontario). J. Appl. Phys. 44: No. 8, 3734-3738 (Aug 1973).

A simple point-contact tunneling device for examination of the properties of almost any metal, alloy, or compound of almost any shape is described. The device has a small mass to permit dipping into liquid helium directly from room temperature. The stability and accuracy of the drive mechanism permit it to be used for single-particle superconductive tunneling as well as for Josephson devices, weak links, and metal-metal bridges. Experimental results showing a recording of the drive characteristics of the differential screw, the transition from Josephson weak-link behavior to single particle tunneling for a Nb-I-Vycor (Pb) sample, a well-resolved energy gap for niobium, and the phonon structure of lead are presented. (auth)

31290 SUPERCONDUCTING PADDLE WHEELS, SCREWS, AND OTHER PROPULSION UNITS FOR HIGH-SPEED GROUND TRANSPORTATION. Davis, L.C.; Borcherts, R.H. (Ford Motor Company, Scientific Research Staff, Dearborn, Michigan 48121). J. Appl. Phys. 44: No. 7, 3294-3299 (July 1973).

High-speed ground vehicles magnetically suspended above a continuous aluminum guideway by superconducting coils can have a clearance of 0.1-0.3 m. To take full advantage of the large clearance, a propulsion system with a comparable clearance is needed. Two such systems based upon physically moving static magnetic fields produced by superconducting coils are proposed. With the use of a prime mover such as a gas turbine or a diesel engine, these systems avoid power collection problems and should result in a lower-weight propulsion unit. A numerical analysis of each has been made to determine the thrust, the lift force, and the efficiency as a function of various parameters. The mechanical efficiency of the paddle wheel appears to have a maximum of ≈60% at 483 km/h (300 mph), while that of the superconducting screw is (1-slip) for an infinitely long machine. End effects will degrade the efficiency somewhat for a screw of finite length. (auth)

31291 JOSEPHSON JUNCTION MIXING. Thompson, E.D. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Appl. Phys. 44: No. 7, 3310-3311 (July 1973).

It is shown that a Josephson junction, biased at a voltage V_0 and driven simultaneously by two monochromatic sources at the frequencies ω_1 and ω_2, produces an output power at the frequency $\omega_3 = \omega_1 - n\omega_2$ and that this frequency is independent of the Josephson frequency $\omega_0 = 2eV_0/\hbar$. The power output depends upon the dc bias, showing fine structure with a voltage periodicity of $\hbar\omega_2/2e$. (auth)

31292 JOSEPHSON JUNCTION INTERFERENCE GRATING. Stuehm, D.L.; Wilmsen, C.W. (Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80521). J. Appl. Phys. 44: No. 6, 2881-2886 (June 1973).

The maximum current through multiple Josephson structures as a function of applied magnetic field is presented. Particular emphasis is placed on the Josephson penetration depth effects and geometrical considerations. The symmetrical and asymmetrical current feed two-, three-, four-, and five-junction gratings are analyzed and discussed. The Josephson penetration depth is shown to control the amplitude of the interference and diffraction patterns of the interference grating. In addition the interior-junction-length/interference-loop-area product is shown to control the operating mode of the interference grating. The dependence of the magnetic field sensitivity and interference pattern amplitude on the number of junctions is discussed. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstract 31263.

31293 (BNL-17541) ENDF/B SUMMARY DOCUMENTATION. (Brookhaven National Lab., Upton, N. Y.). May 1973. Contract AT(30-1)-16. 330p. (ENDF-201). Dep. NTIS $18.50.

A localized source of descriptions for the evaluations contained in the ENDF/B Library is provided. The summary documentation presented is intended to be more detailed than the (File 1) comments contained in the computer-readable data files, but not so detailed as the formal reports describing each ENDF/B evaluation. A loose leaf-independent section format was selected for ease of updating. The publication is presented in sections, each describing one (or more) ENDF evaluations and identified by Z and A. The principal part of the library consisting of 133 materials with neutron cross sections specified for all relevant reactions is described. (RWR)

31294 (CEA-N-1604) SYNTHETIC SLOWING-DOWN MODELS AND THE C_n METHOD. Applications to Fast Neutron Exponential Experiments. Lorain, H. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1973. 262p. (In French). Dep. NTIS (U.S. Sales Only) $15.25.

Thesis. Submitted to Paris Univ., Orsay, France.

The fast neutron exponential experiments can only be interpreted using transport theory, since the space and energy transients are of great importance. A numerical solution based on a lemma of G. Placzek is presented. This theorem allows the flux in a finite medium to be calculated by calculating the flux in the same medium extended over the whole of space by the introduction of surface boundary sources in the medium. These sources are solution of an integral equation whose kernel is the Green's function of the infinite medium. After the Fourier transform is performed, it is shown, using several synthetic slowing-down models, that these Green's functions can be found analytically. The fitting of these models and their properties are studied in detail. The inverse Fourier transform for the Green's function is performed using a numerical integration over a path carefully chosen in the complex plane. The integral equation is solved using the C_N method which expands the boundary sources in terms of functions dependent on the angular variables. The method is adapted to HUG and PHUG exponential experiments. Fission rates are calculated for various detectors, and a linear combination of the different rates is given in order to minimize the boundary effect. Evidence is given showing the importance of the neutrons coming directly from the source (reactor). (FR)

31295 (CEA-N-1658) C_n METHOD FOR SOLVING THE NEUTRON TRANSPORT EQUATION IN SPHERICAL GEOMETRY. Comparison with the Results of the Critical Godiva and Jezebel Experiments. Mordant, M. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). May 1973. 249p. (In French). Dep. NTIS (U.S. Sales Only) $14.50.

The C_n method was used to solve the Boltzmann equation in a spherical geometry. A new expression is first obtained for the monoenergetic Green's function in an infinite homogeneous medium. The diffusion may be isotropic or linearly anisotropic and the medium may or may not be multiplying. The method was tested on some typical neutron transport problems: calculation of the critical radius of a bare sphere, the albedo or extrapolation length in an infinite medium surrounding a black sphere, the albedo or transmission across a medium limited by two concentric spheres, or the critical thickness for a spherical core. In the framework of polyenergetic theory, the Green's function representing the angular flux produced by a shell source was studied using a synthetic slowing-down model. The results obtained from the calculation of the critical radius of a bare sphere are comparable with the results of the critical Godiva and Jezebel experiments. (auth)

31296 (FEI-324) NEUTRON SPECTRA IN NONHOMOGENEOUS MEDIA. Kuznetsov, V. A.; Mogil'ner, A. I.; Bankrashkova, M. Ya. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1972. 30p. (In Russian). INIS.

The experimental and calculated spectra of neutrons in $ZrH_{1.56}$ emsembles, containing irregularly dispersed absorbers, and nearby B_4C rods in assemblies with Be moderators were examined. The measurements of the neutron spectra in the $ZrH_{1.56}$ ensemble were done by the time of flight method using a pulsed neutron source. The neutron spectra in the Be was measured by means of a mechanical selector using the integral method. The methods for the calculation of the cross section and the neutron spectra in the P_1 approximation were described. It was shown that the experimental and calculated data converge satisfactorily. A comparison of the calculated and experimental data was made in the neutron energy range $\sim 0.01 \leq E \leq 0.67$ ev in which the range of the experimental study ($\sim$0.01 to 10 ev) and the 15-group calculation of the neutron spectra (0 to 0.67) overlapped. (tr-auth)

31297 (ITJ-32) GENERALIZATION OF THE MULTIGROUP APPROACH FOR CALCULATING THE NEUTRON SLOWING DOWN LENGTH. Kreft, A. (Institute of Nuclear Techniques, Krakow (Poland)). Nov 1972. 57p. Dep. NTIS (U. S. Sales Only) $5.45.

An original method for calculating the neutron slowing down length, using a generalized multigroup approach, is presented. Unlike other multigroup methods, this method takes into account all the basic phenomena involved in the neutron transport, i.e. the elastic scattering, the inelastic scattering and the neutron absorption. The procedure for calculating L_s for polyenergetic neutron source is given together with its theoretical substantiation. The procedure applies for soils and rocks of any chemical composition and for all neutron sources which energies do not exceed 10.5 MeV. The FORTRAN programs for computations are enclosed. Results of calculations the media being water-saturated sandstone and limestone of different porosity (from 0% up to 100%) are presented for monoenergetic neutrons and for radioisotope Ra–Be and Pu–Be neutron sources. A good agreement between the calculated L_s values and available experimental values of other authors can be observed both for water and for weakly slowing down media, i.e. dry sandstone and dry limestone. For the media containing relatively small amounts of hydrogen a non-monotonic dependence of the slowing down length on the neutron initial energy has been observed. (auth)

31298 (KFK-1697) NEUTRON THERMALIZATION IN LIQUID ORTHO- AND PARA-HYDROGEN. Wuerz, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). May 1973. 122p. (In German). Dep. NTIS (U. S. Sales Only) $8.25.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

The neutron thermalization properties of liquid ortho-para-hydrogen mixtures at T = 20,4 °K are investigated. For this purpose stationary and asymptotic neutron leakage spectra are measured for opH_2-mixtures ranging from 33% pH_2 to 98% pH_2. Furthermore the first time moment and the variance of thermal neutrons were measured for two mixtures of 77% pH_2 and 98% pH_2. The influence of spin reversal processes, due to the spin-dependent neutron proton interaction, on the thermalization properties of the H_2 molecule is clearly shown. By taking into account the dynamics of the liquid in calculating the scattering kernel good agreement between theory and experiment is achieved. (auth)

31299 BACKSCATTERING OF NEUTRONS FROM PERFECT SILICON SINGLE CRYSTALS. Heidemann, A.; Scholz, J. (Technische Univ., Munich). Z. Phys.; 263: No. 4, 291-298(1973). (In German).

A neutron backscattering diffractometer is described. Using this instrument, we measured the Bragg reflections of neutrons which are backscattered from the (111)- and the (333)-lattice planes of silicon single crystals. The relative line widths of the (111)-reflex, $(\Delta a/a)_{111} = 3.3 \times 10^{-5}$, and that of the (333)-reflex, $(\Delta a/a)_{333} = 6.8 \times 10^{-6}$, are broader than the theoretical values of $(\Delta a/a)_{111} = 3.0 \times 10^{-5}$ and $(\Delta a/a)_{333} = 3.2 \times 10^{-6}$. The additional broadening of 3×10^{-6} is due to experimental inaccuracies. The measured integrated reflectivities for both reflexes agreed with the theory. (5 figures, 2 tables) (auth)

31300 COUPLING OF FORWARD AND ADJOINT CALCULATIONS TO SOLVE THREE-DIMENSIONAL DEEP PENETRATION PROBLEMS. Slater, C. O. Knoxville, TN; Univ. of Tennessee (1973). 128p. University Microfilms Order No. 73-20,034.

Thesis (Ph. D.)

To calculate some effect of interest within a target located in the radiation field of a very distant source, "three-step" procedure was developed and applied to several problems. The targets were of simple and complex geometries, and some contained fissile material. Results were obtained for several orientations and displacements of the target with respect to the source. These results were compared with those obtained with two-step procedure. In general, the three-step-procedure results for the effect of interest showed good agreement with the two-step-procedure results. The good agreement between the surface integral approximation and the adjoint difference method for

fissile material applications demonstrated the general applicability of the two approaches to such applications. (RWR)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 31135 and 31376.

31301 (CONF-730301-P1, pp 147-148) RATIO $\sigma(\gamma,p)/\sigma(\gamma,n)$ FOR ^{4}He. Irish, J. D. (Univ. of Toronto); Johnson, R. G.; Thomas, B. J.; Berman, B. L.; McNeill, K. G.; Jury, J. W. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
Measurements were made of the angular distribution of photoneutrons from a liquid ^{4}He target and of the 98° differential cross section (relative to D) using a gaseous ^{4}He target. From these the total cross section $\sigma(\gamma,n)$ was determined in the photon energy range from 21 to 31 MeV. Using $\sigma(\gamma,p)$ from other work, the ratio $\sigma(\gamma,p)/\sigma(\gamma,n)$ for ^{4}He is shown. (LTW)

31302 (CONF-730301-P1, pp 149-150) CROSS SECTION AND ANGULAR DISTRIBUTION MEASUREMENTS OF THE ^{4}He$(\gamma,n)^3$He REACTION. Webb, D. V.; Malcolm, C. K.; Shin, Y. M.; Skopik, D. M. (Univ. of Saskatchewan, Saskatoon). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The ^{4}He(γ,n) cross section was measured simultaneously at five angles using TOF techniques. A liquid target was used at five initial LINAC electron energies to assess the contribution of the many-particle breakup modes that could contribute to the (γ,n) cross section. The total cross section was calculated from the angular distribution. (LTW)

31303 (CONF-730301-P1, pp 323-335) PHOTODISINTEGRATION OF THE DEUTERON: THEORY. Breit, G. (State Univ. of New York, Buffalo). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The history and present status of the theory of deuteron photodisintegration are reviewed. Numerous theoretical results are presented graphically. It is concluded that there are no logically satisfying theoretical developments. (LTW)

31304 (CONF-730301-P1, pp 345-359) PHOTODISINTEGRATION OF DEUTERIUM AT LOW AND MEDIUM ENERGIES. Shin, Y. M. (Univ. of Saskatchewan, Saskatoon). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
A summary of the present experimental status of the photodisintegration of deuterium is given. Recent experimental results indicate that current theories are inadequate to account for the disintegration process. In particular, some experiments show that the E1 transition amplitudes in the photodisintegration require primary theoretical attention. On the other hand measured cross sections of the electrodisintegration process are not inconsistent with theoretical predictions. Thus, while currently available theories are challenged by the experimental results, experiments with higher precision are urgently needed for the electromagnetic disintegration of the deuteron in order to further understand the process. (auth)

31305 (CONF-730301-P1, pp 363-371) DEUTERON MODELS FOR PHOTODISINTEGRATION FROM ELECTRON SCATTERING. Dally, E. B. (Naval Postgraduate School, Monterey, CA). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
Some experimental results for photodisintegration of the deuteron are presented and discussed. The question whether the deuteron models used to compare these data with theory are valid or not is examined. It is shown that models are available that very adequately describe the elastic electron deuteron scattering process at low q^2. One would expect that these models should be adequate for the photodisintegration interaction. (auth)

31306 (CONF-730301-P1, pp 385-398) PHOTODISINTEGRATION OF HELIUM 4. Meyerhof, W. E.; Fiarman, S. (Stanford Univ., CA). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
Cross sections and angular distributions of the reactions ^{4}He$(\gamma,p)^3$H, ^{4}He$(\gamma,n)^3$He, ^{4}He$(\gamma,d)^2$H, ^{4}He$(\gamma,pn)^3$H, and ^{4}He$(\gamma,2p2n)$ are reviewed. Where possible, a separation into multipoles (E1,E2) is made. Shell-model resonance calculations and fits are compared with the data. The experimental evidence is consistent with, but does not determine uniquely, the existence of T = 1, 1^- states near 27 and 30 MeV and of a T = 0, 2^+ state above 30 MeV in ^{4}He. The E1 and E2 giant resonances in the (γ,p) and (γ,n) reactions exhaust the sum rules. (25 references) (auth)

31307 (CONF-730301-P1, pp 467-468) D(e,e′)n: EXPERIMENT AND THEORY. Cong, K. F.; Phenneger, M. C.; Shin, Y. M.; Skopik, D. M.; Tomusiak, E. L. (Univ. of Saskatchewan, Saskatoon). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
Angular and energy distributions of protons from the D(e,e′p)n reaction are calculated and compared with experimental results. (LTW)

31308 (CONF-730301-P1, pp 469-471) EFFECT OF ISOBAR CONFIGURATIONS IN THE DEUTERON. Miller, H. G. (Univ., Frankfurt am Main); Arenhoevel, H. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
Studies of the effects of nuclear polarization in elastic electron scattering and photodisintegration of the deuteron are summarized, without explicitly including meson exchange contributions. (LTW)

31309 (CONF-730301-P1, pp 473-474) E2 CONTRIBUTION TO PHOTODISINTEGRATION OF A = 3 AND 4 NUCLEI. Bhatt, S. C. (Univ. of Alberta, Edmonton). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
E2 contributions to the cross sections for photodisintegration of T, ^{3}He, and ^{4}He are calculated. (LTW)

31310 (CONF-730301-P1, pp 475-477) ^{4}He(γ,d)d: CONTRIBUTION TO THE ISOSCALAR CHANNEL IN ^{4}He PHOTODISINTEGRATION. Erdas, F.; Pompei, A.; Quarati, P. (Univ., Cagliari, Italy). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The harmonic oscillator sum rules were used to calculate the contribution of the ^{4}He(γ,d)d reaction to the E2 isoscalar component in ^{4}He photodisintegration. (LTW)

31311 (CONF-730301-P1, pp 479) EVIDENCE FOR CHARGE SYMMETRY BREAKING IN THE ^{4}He$(\gamma,n)^3$He AND ^{4}He$(\gamma,p)^3$H REACTIONS. Stephenson, G. J. Jr.; Gibson, B. F. (Los Alamos Scientific Lab., NM). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The oscillator shell model was used to calculate the matrix elements between the basis states of good isospin in (γ,n) and (γ,p) reactions on ^{4}He. (LTW)

31312 (CONF-730301-P1, pp 573-581) MEDIUM ENERGY PHOTONUCLEAR REACTIONS. Tzara, C. (CEN de Saclay, Gif-sur-Yvette, France). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
Recent experiments on electromagnetic excitation of light nuclei between 100 and 400 MeV are reviewed. One emphasizes the interest of exploring these reactions outside of the quasi-free kinematics. The appearance of a fine structure in the pion photoproduction and some possible explanations are discussed. (auth)

31313 (CONF-730301-P2, pp 883-884) MODEL INDEPENDENT ANALYSIS OF ELASTIC ELECTRON SCATTERING DATA ON ^{3,4}He. Sick, I. (Univ. of Basel). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31314 (CONF-730301-P2, pp 925-926) RESONANT STRUCTURE IN THE ^{3}He$(^3$He,$\gamma)^6$Be CAPTURE REACTION. Ventura, E.; Calarco, J. R.; Chang, C. C.; Diener, E. M.; Meyerhof, W. E. (Stanford Univ., CA). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31315 (CONF-730301-P2, pp 957-965) PROPOSAL REGARDING (γ,p) AND (p,γ) EXPERIMENTS AT MEDIUM ENERGIES.

Eisenberg, J. M.; Noble, J. V.; Weber, H. J. (Univ. of Virginia, Charlottesville). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Experiments on (γ,p) or (p,γ) reactions in the energy range near 200 MeV are proposed as a means of yielding complementary information to recent studies of the (p,π^+) and (π^+,p) reactions. Since a major source of uncertainty in these latter reactions is the behavior of the pion wave function for large momentum transfer, the photonuclear version of these experiments would have the virtue of allowing for greater concentration on probing the high momentum components of the nuclear wave function. A rough calculation of the (p,γ) reaction on ^{12}C indicates cross sections of the order of a nanobarn, which should be just barely observable with the necessary 1-MeV resolution using modern, copious sources of protons. (auth)

31316 (CONF-730301-P2, pp 979-980) ^{6}Li(γ,p) AND ^{7}Li(γ,p) REACTIONS AT E_γ = 60 MeV. Gardiner, S. N.; Matthews, J. L.; Owens, R. O. (Univ. of Glasgow). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31317 (CONF-730301-P2, pp 1057-1058) PHOTODISINTEGRATION OF ^{3}He FROM 11 TO 65 MeV. Ticcioni, G.; Gardiner, S. N.; Matthews, J. L.; Owens, R. O. (Univ. of Glasgow). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31318 (ISN-1972) ANNUAL PROGRESS REPORT, 1972. (Grenoble Univ. (France). Institut des Sciences Nucleaires). 1972. 156p. (In French). Dep. NTIS (U.S. Sales Only) $10.00.

The cyclotron equipment is presented together with the experiments carried out with the cyclotron, equipment used and results in radioactivity experiments, experiments carried out using the High Flux Reactor, and the work of the theoretical nuclear physics study team. (FR)

For abstracts of individual papers see: 30731, 31135, 31319–31321, 31374, 31434, 31454, 31484, 31485, 31511, 31512, 31555, and 31556.

31319 (ISN-1972, pp 45-46) ELASTIC SCATTERING OF POLARIZED DEUTERONS BY H AND ^{4}He. Arvieux, J.; Fiore, A.; Merchez, F.; Darves-Blanc, R.; Gondrand, J. C.; Nguyen Van Sen; Perrin, G. 1972. (In French).

Vector and tensor analyzing powers were measured for the elastic scattering of polarized deuterons by H and ^{4}He. Good agreement is obtained with Faddeev-type calculations for the first reaction when P-wave nucleon–nucleon interactions are taken into account. (FR)

31320 (ISN-1972, pp 48-49) COMPARISON OF $\vec{p}$ + ^{3}H AND $\vec{p}$ + ^{3}He ELASTIC SCATTERING AT 19 AND 30 MeV. Darves-Blanc, R.; Nguyen Van Sen; Arvieux, J.; Gondrand, J. C.; Fiore, A.; Perrin, G. 1972. (In French).

The differential cross section and the proton analyzing power encountered in p + ^{3}H elastic scattering at 19 and 30 MeV were measured using a polarized proton beam and compared with p + ^{3}He data. (auth)

31321 (ISN-1972, pp 87-91) MEASUREMENT OF THE COEFFICIENTS OF SPIN CORRELATION IN ELASTIC DEUTERON–PROTON SCATTERING AT 17.4, 19.5, 23.8, AND 26.1 MeV. Chauvin, J. (CEN de Saclay, Gif-sur-Yvette, France); Garreta, D.; Fruneau, M. 1972. (In French).

The coefficients of spin correlation were measured for elastic deuteron–proton scattering with polarized deuterons having energies of 17.4, 19.4, 23.8, and 26.1 MeV and a polarized proton target. (FR)

31322 (NP-19855) PROTON TOTAL CROSS SECTIONS ON ^{1}H, ^{2}D, ^{4}He, ^{12}C, AND ^{16}O IN THE ENERGY RANGE 180 TO 560 MeV. Schwaller, P. (European Organization for Nuclear Research, Geneva (Switzerland)). 1972. 55p. Dep. NTIS (U.S. Sales Only) $4.75.

Thesis. Submitted to Swiss Federal Inst. of Tech., Zurich.

Proton total cross sections on ^{1}H, ^{2}D, ^{4}He, ^{12}C, and ^{16}O were measured in the energy range 180 to 560 MeV in a high-precision transmission experiment with a statistical accuracy of ±0.2%. Random errors were typically ±0.5% for pp data, ±1% for ^{2}D and ^{4}He, and ±(1 to 3%) for ^{12}C and ^{16}O total cross sections. Systematic errors of ±(0.8 to 1%) in the ^{1}H and ^{2}D data originate mainly from uncertainties in applying the correct Coulomb–nuclear interference corrections to the measured partial cross sections before extrapolating to the total cross section at zero solid angle. The real parts of the nuclear spin-independent forward scattering amplitudes on ^{4}He, ^{12}C, and ^{16}O were obtained in the same experiment by analyzing the angular dependence of the partial cross sections in the Coulomb–nuclear interference region. Total cross sections were calculated in a Glauber-model approach, and the results are compared to these data. (24 figures, 11 tables) (auth)

31323 REACTION ^{3}H(^{3}He,d)^{4}He AT VERY LOW ENERGIES: ENERGY DEPENDENT VIOLATIONS OF THE BARSHAY–TEMMER ISOSPIN THEOREM AND HIGHLY EXCITED STATES IN ^{6}Li. Nocken, U.; Quast, U.; Richter, A.; Schrieder, G. (Ruhr Univ., Bochum, Ger.). Nucl. Phys.; A213: No. 1, 97-106(1973).

Angular distributions of the reaction ^{3}H(^{3}He,d)^{4}He were measured at E(^{3}He) = 291, 369, 600 and 800 keV and were found on the average to be symmetric about 90° in the cm system, in accord with the Barshay–Temmer isospin theorem. The slight asymmetries (≤ 1%) together with the energy dependence of larger asymmetries from other experiments suggest strongly isospin mixing in the compound nucleus ^{6}Li. (auth)

31324 ^{3}He(d,p)^{4}He REACTION PROTON ASYMMETRY WITH POLARIZED ^{3}He BEAM. Kato, S. (Osaka Univ.); Aoki, Y. J. Phys. Soc. Jap.; 34: No. 5, 1128-1131(May 1973).

The left–right cross section asymmetry has been measured for the D(^{3}He,p)^{4}He reaction with a polarized ^{3}He beam at the bombarding energy of 9 MeV in the laboratory angular range from 30° to 10°, corresponding to 140° to 170° in the center-of-mass system. The results combined with data on proton polarization and deuteron analyzing power of the reaction are compared with the prediction of Yazaki and Tanifuji. (auth)

31325 SPATIAL LOCALIZATION EFFECTS IN THE ^{2}H(d,pd)n REACTION. von Witsch, W. (Institut für Strahlen- und Kernphysik der Universität Bonn, D53 Bonn, Germany); Mutchler, G. S.; Phillips, G.C.; Miljanić, D. Phys. Rev. C 8: No. 1, 403-407 (July 1973).

A phenomenological explanation is proposed for the pronounced peaks observed in some coincidence spectra of the ^{2}H(d,pd)n reaction at low relative energies in the proton–neutron system. It is shown that the density-of-states formalism of Phillips, Griffy, and Biedenharn which includes explicitly the fact that the p–n system is produced in a spatially localized state can describe the observed spectral shapes with the pure, isospin-allowed, $^3S_1$ proton–neutron final-state interaction. In addition, the model satisfactorily describes the case of low relative energy between the deuteron and neutron. (auth)

31326 EXACT N–^{2}H BREAKUP CALCULATIONS. Jain, M.; Doolen, G.D. (Cyclotron Institute and Physics Department, Texas A & M University, College Station, Texas 77843). Phys. Rev. C 8: No. 1, 124-128 (July 1973).

The fivefold differential cross section computed from the exact solution of the three-particle Faddeev equations for separable spin-dependent s-wave nucleon–nucleon interactions is compared with the data from the recent kinematically complete measurement of ^{2}H(p,2p)n reaction at 39.5 MeV in 4π geometry. The calculations agree well with the data, which includes regions of phase space where quasifree scattering and final state interactions are not the predominant reaction mechanisms. (auth)

31327 ^{2}H(^{2}H,dp)n REACTION. Bonbright, D. I.; Allas, R. G.; Bondelid, R.O.; Petersen, E.L.; Pieper, A.G.; Theus, R.B. (Naval Research Laboratory, Washington, D. C. 20390); Slaus, I. Phys. Rev. C 8: No. 1, 114-119 (July 1973).

The d + d → d + p + n breakup reaction was studied over a range of bombarding energies E_d = 14–36 MeV. The proton and deuteron were detected at angle pairs chosen to either emphasize quasifree scattering (QFS) or the n–p final-state interaction (FSI). It was found that by using a smooth cutoff for the deuteron wave function, a modified plane-wave impulse-approximation (PWIA) theory could fit the magnitude and shape of the observed QFS peaks. To fit the QFS plus FSI data only triplet FSI was needed in contrast to some earlier results that indicated a strong singlet FSI. The singlet FSI contribution to the cross sections was estimated to be less than 1% in all cases studied. (auth)

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Refer also to abstracts 29961, 31314, 31315, 31322, 31323, 31395, 31408, 31432, 31435, 31436, 31451, 31486, 31497, 31531, 31538, 31588, 31589, 31592, 31608, 31611, 31616, 31624, 31626, 31628, 31631, and 31632.

31328 (CONF-730301-P1, pp 23-36) TOTAL PHOTONUCLEAR CROSS SECTIONS, PARTICULARLY ABOVE 30 MeV.

Ahrens, J.; Eppler, H. B.; Gimm, H.; Gundrum, H.; Kroening, M.; Riehn, P.; SitaRam, G.; Zieger, A.; Ziegler, B. (Max Planck-Institut fuer Chemie, Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Total photon absorption cross sections for low-atomic-number nuclei were measured. The integrated cross section between particle and meson thresholds amounts to 1.5 to 2 classical sums. It is shown that one can apply a simple photoionization model for the description of the main features in the "giant resonance" region. This part of the cross section is made to contain one single classical sum. The remaining cross section is distributed over a large energy range whose position and width is proportional to $A^{-\frac{1}{3}}$. Structures observed in this region correspond to Goldhaber–Teller resonances and overtones thereof (E1, E2, E3, E1′, E2′). The parameters in the photoionization model, which give a good fit to the experimental data, are used to calculate RMS radii and separation energies which agree well with known values. (auth)

31329 (CONF-730301-P1, pp 133-146) ANGULAR DISTRIBUTION AND POLARIZATION FOR THE $^{16}O(\gamma,n_0)^{15}O$ REACTION. Wang, W. L. (Carnegie-Mellon Univ., Pittsburgh). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The angular distribution and polarization of the neutrons produced in the photodisintegration of ^{16}O are calculated in a doorway-state formulation previously applied to the calculation of the total cross section. The previous work dealt with the intermediate structure in the dipole region; this structure was shown to be due to mixing of 3p-3h states with the giant-dipole 1p-1h states. The 3p-3h states are the secondary doorways coupled to the 1p-1h doorways, which are in turn coupled to the open channels. It is shown that the angular distribution and polarization can also be reproduced with this model. Phenomenological E2 amplitudes much stronger than the simple direct amplitudes are required. This feature is interpreted as evidence for a "giant-quadrupole" excitation in this region. It is also concluded that current procedures for the extraction of various E1 amplitudes, in the dipole approximation, from the experimental data must be modified because of the importance of E2 amplitudes in the giant-resonance region. Several predictions of the effects of the E2 amplitudes, which may be easily tested by further experiments, are also shown. (auth)

31330 (CONF-730301-P1, pp 151-152) $^{9}Be(\gamma,Tn)$ CROSS SECTION. Hughes, R. J.; Sambell, R. H.; Spicer, B. M. (Univ. of Melbourne, Parkville, Australia). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The absolute cross section of the $^{9}Be(\gamma,Tn)$ reaction was measured from threshold to 28 MeV using a betatron bremsstrahlung beam. The measurement is generally in good agreement with previous experiments except for a factor of about 2 in the absolute magnitude. (LTW)

31331 (CONF-730301-P1, pp 153-154) $^{10}B(\gamma,Tn)$ AND $^{11}B(\gamma,Tn)$ CROSS SECTIONS. Hughes, R. J.; Spicer, B. M. (Univ. of Melbourne, Parkville, Australia). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Absolute measurements were made of the $^{10}B(\gamma,Tn)$ and $^{11}B(\gamma,Tn)$ cross sections from threshold to 28 MeV. Both targets were made of pressed boron powder which formed solid, self-supporting pellets. The measured cross sections are compared with those of other workers. No evidence is seen for a very sharp structure at higher energies. For ^{10}B the giant resonance is broad and peaks around 23 MeV, with the major structure contained in two peaks at 20.1 ± 0.1 and 23.1 ± 0.1 MeV. The ^{11}B cross section, which agrees with most other work, exhibits a maximum at 25.2 ± 0.1 MeV and, like the ^{10}B cross section, shows structure superimposed on a giant resonance. (LTW)

31332 (CONF-730301-P1, pp 155-156) POLARIZATION OF GROUND STATE PHOTONEUTRONS FROM ^{12}C AT 45° AND 90°. Nath, R.; Fink, F. W. K.; Holt, R. J.; Schultz, H. L. (Yale Univ., New Haven). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Photoneutron polarization in the reaction $^{12}C(\gamma,n_0)^{11}C$ was measured at 45° and 90° in the photon energy range 22 to 31 MeV. (LTW)

31333 (CONF-730301-P1, pp 157-158) PHOTONEUTRON ANGULAR DISTRIBUTIONS FROM ^{12}C. Jury, J. S.; Hewitt, J. S.; McNeill, K. G. (Univ. of Toronto). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The multipolarity of photon absorptions in the giant resonance of ^{12}C was studied by measuring the energies and angular distributions of photoneutrons emitted in decays to the ground state of ^{11}C. Neutron spectra were recorded at 7 angles from 60° to 146° relative to a 10-nsec-wide pulsed bremsstrahlung beam. (LTW)

31334 (CONF-730301-P1, pp 159-160) ANGULAR DISTRIBUTION OF PHOTONUCLEONS IN THE GIANT DIPOLE RESONANCE OF ^{12}C. Beck, F.; Birkholz, J. (Technische Hochschule, Darmstadt, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The Legendre coefficient A_2 in the formula for the differential (γ,x) cross section (X = n or p) was calculated in an open-shell description of the giant resonance using a separation approximation for the solution of the continuum shell model equations. (LTW)

31335 (CONF-730301-P1, pp 161-162) $^{14}N(\gamma,p_2)$ CROSS SECTION AND ANGULAR DISTRIBUTION. Baglin, J. E. E. (Iowa State Univ. of Sci. and Tech., Ames); Bentz, E. J. Jr. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Simultaneous measurements were made of cross sections and angular distributions for both (γ,p_0) and (γ,p_2) reactions. The coefficients A_0, A_1, A_2, A_3, or their ratios to A_0 are shown. (LTW)

31336 (CONF-730301-P1, pp 163-164) POLARIZATION OF PHOTONEUTRONS FROM THE $^{16}O(\gamma,\vec{n}_0)^{15}O$ REACTION. Nath, R.; Cole, G. W.; Fink, F. W. K.; Holt, R. J.; Schultz, H. L. (Yale Univ., New Haven). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The polarizations of ground-state photoneutrons emitted from the dipole states ^{16}O were measured at 45° and 90°. (LTW)

31337 (CONF-730301-P1, pp 165-166) ELECTRON AND PHOTODISINTEGRATION ON ^{12}C AND ^{19}F. Moreira, J. R.; Wolynec, E.; Moscati, G. (Univ., Sao Paulo, Brazil). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Two thin teflon targets were irradiated in the electron beam of a linear accelerator. The residual activities were followed through many half-lives, so that the initial activities of ^{11}C and ^{18}F were obtained with an error of the order of a few percent. The experimental ratio of yields of photo- to electrodisintegration is shown vs. incident energy. The ratio is smoother in ^{18}F than in ^{11}C, suggesting a more enhanced fine structure behavior in ^{12}C than in ^{19}F. (LTW)

31338 (CONF-730301-P1, pp 167-168) PHOTONEUTRON CROSS SECTION OF ^{19}F. Sherman, N. K.; Lokan, K. H.; Gellie, R. W. (National Research Council, Ottawa). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Photoneutron TOF spectra of ^{19}F produced by bremsstrahlung at 1-MeV end-point energy intervals between 13 and 21 MeV were measured at 90° with a 0.2 nsec/m resolution using a teflon target. Differential cross sections were deduced from the measured spectra. (LTW)

31339 (CONF-730301-P1, pp 175-176) PHOTONEUTRON CROSS SECTIONS FOR ^{7}Li. Bramblett, R. L.; Berman, B. L.; Kelly, M. A.; Caldwell, J. T.; Fultz, S. C. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The (γ,n) and $(\gamma,2n)$ cross sections for ^{7}Li were measured from threshold up to 30.5 MeV with 3% energy resolution using monoenergetic photons produced by positron annihilation in flight and neutron-multiplicity counting. The (γ,n) and $(\gamma,2n)$ cross sections have approximately equal strength. The total photoneutron cross section rises sharply from 10 MeV to reach a broad plateau of about 1.5 mb from 14 to 20 MeV, decreases more slowly to about 0.5 mb at 26 MeV, and then remains relatively constant up to 30 MeV. (LTW)

31340 (CONF-730301-P1, pp 481-482) INTEGRATED PHOTODISINTEGRATION CROSS SECTION FOR ^{6}Li. Mahanti, D.; Srivastava, B. K. (Indian Inst. of Tech., Kharagpur). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The integrated photodisintegration cross section of ^{6}Li was calculated in the electric-dipole approximation using a central velocity-dependent potential. The results of the calculation for a Serber force mixture and for a Biel force mixture are tabulated and compared with experiment. (LTW)

31341 (CONF-730301-P1, pp 485-488) DECAY OF THE PHOTO GIANT RESONANCE OF 1p SHELL NUCLEI. Kissener, H. R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Aswad, A.; Jaeger, H. U.; Eramzhian, R. A. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Several partial and total absorption cross sections for ^{7}Li and ^{14}N are shown, indicating how different final levels are fed by different parts of the giant resonance. The branching ratios to some levels in the residual nuclei are tabulated. The analysis confirmed a number of features of the decay of the dipole resonance in light nuclei. Calculated results are in acceptable agreement with experimental data. (LTW)

31342 (CONF-730301-P1, pp 493-494) SHELL-MODEL WITH THE ONE PARTICLE CONTINUUM FOR THE DIPOLE GIANT RESONANCE OF MASS-13 NUCLEI. Marangoni, M.; Ottaviani, P. L.; Saruis, A. M. (CNEN, Bologna). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A shell-model calculation including the one-particle continuum for the dipole photoreaction cross sections in mass-13 nuclei at the giant resonance energy region is briefly discussed. (LTW)

31343 (CONF-730301-P1, pp 495-496) COEXISTENCE MODEL FOR EXCITATIONS IN ^{16}O. Goswami, A. (Univ. of Oregon, Eugene); Graves, R.; Nalcioglu, O. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The complexity of the observed dipole resonance in ^{16}O is indicative of additional degrees of freedom which are introduced through the shape-coexistence model. Results obtained with the model are reported. The ground-state correlation due to phonon excitations is taken into account. The partial and total rates of muon capture by ^{16}O leading to the 0^-, 1^-, and 2^- analog states in ^{16}N are also calculated. (LTW)

31344 (CONF-730301-P1, pp 511-524) STRUCTURE OF THE DIPOLE RESONANCE IN PHOTONUCLEAR REACTIONS. Ishkhanov, B. S. (Moscow State Univ.); Shevchenko, V.G. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Aspects of the structure of the dipole resonance in the interaction of photons with light, intermediate, and heavy nuclei are studied. The results have been obtained at a betatron with E_{max} = 35 MeV by using automatic change of the energy of the gamma beam. The results are compared with theoretical models. (auth)

31345 (CONF-730301-P1, pp 603-604) DOUBLE-NUCLEON EMISSION FOLLOWING PION ABSORPTION WITH A THREE-BODY DESCRIPTION OF THE FINAL STATE. Garcilazo, H. (Univ., Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The transition rate for the reaction ^{12}C(π^-,NN)^{10}B was calculated in first-order perturbation theory. The nucleon angular and energy distributions are shown. (LTW)

31346 (CONF-730301-P1, pp 605-606) RADIATIVE π^- ABSORPTION IN LIGHT NUCLEI. Vergados, J. D. (Univ. of Pennsylvania, Philadelphia). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Results of calculated π^- capture rates in ^{6}Li and ^{14}N are reported. (LTW)

31347 (CONF-730301-P1, pp 607-608) MICROSCOPIC DESCRIPTION OF NUCLEAR PRODUCTION AND ABSORPTION OF PIONS. Dillig, M.; Huber, M. G. (Univ., Erlangen Nuernberg, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The plane-wave Born approximation was used to study the ^{12}C(p,π^+) and ^{9}Be(p,π^+) reactions. (LTW)

31348 (CONF-730301-P1, pp 609-610) ATTEMPT TO DETECT GIANT RESONANCE EXCITATION BY (π^+,π^0) REACTION IN ^{12}C. Belluscio, M.; Bonazzola, G. C.; Bressani, T.; Chiavassa, E.; Dellacasa, G.; Fainberg, A.; Ferrero, L.; Freschi, D.; Mirfahkrai, N.; Musso, A.; Naldi, L.; Rinaudo, G. (Univ., Turin). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The results of a search for proton emission following the excitation of the states in ^{12}N isobaric analogs of the giant dipole resonance in ^{12}C are reported. The investigation was performed with the (π^+,π^0) reaction on ^{12}C at 400 MeV/c. (auth)

31349 (CONF-730301-P1, pp 611-612) CHARGED PION PHOTOPRODUCTION FROM ^{12}C WITH EXCITATION OF ANALOG STATES. Lamers, B. A.; Lucas, C. W.; Nagl, A.; Ueberall, H. (Catholic Univ. of America, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The angular distributions of the reaction $\gamma + {}^{12}C \rightarrow \pi^+ + {}^{12}B^*$ were calculated, describing the final T = 1 nuclear levels by a Helm model whose parameters were determined by fitting the model to experimental electron scattering form factors. (LTW)

31350 (CONF-730301-P1, pp 613-614) SINGLE π^- PHOTOPRODUCTION FROM CARBON ABOVE 300 MeV. Anami, S. (Hiroshima Univ.); Baba, K.; Endo, I.; Fujii, H.; Kato, S.; Murakami, A.; Ninomiya, S.; Sumi, Y. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The double differential cross sections for negative pion photoproduction from carbon were measured using a bremsstrahlung beam from a 1.3-GeV electron synchrotron. Pions were detected by a magnetic spectrometer at a laboratory angle of 28.4° with a momentum resolution of 3%. Measurements were made at 11 energies between 323 and 824 MeV. (LTW)

31351 (CONF-730301-P1, pp 713-714) INELASTIC PROTON SCATTERING, AN ALTERNATIVE FOR EXCITING GIANT RESONANCES L = 1 THRU 4 IN THE 16 OXYGEN ISOTOPE. Geramb, H. V. (Inst. for Theoretical Nuclear Physics, Juelich, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The spectroscopy of virtual excitations in inelastic proton scattering and (p,2p) reactions is proposed to study the giant resonances in ^{16}O. (LTW)

31352 (CONF-730301-P2, pp 727-740) GIANT RESONANCE REACTION PRODUCTS. Dixon, J. M. (Univ. of Zambia, Lusaka). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The particle-hole configurations of giant resonance states can be deduced from their cross sections for decay to the ground and excited states of the residual nucleus, and the angular distributions of the particles emitted. Experimental results for ^{16}O, ^{14}N, and ^{12}C are presented and discussed. The giant resonance region of each of these nuclei decays predominantly to states which can be described as a single $1p_{\frac{1}{2}}$ or $1p_{\frac{3}{2}}$ hole in the ground state. Current experimental values for the branching ratios for particle decay of ^{12}C and ^{14}N to various residual states are consistent with theoretical predictions, but those for ^{16}O are not. The angular distribution coefficients, together with polarization data, provide some information about the relative amplitudes of emitted partial waves. However, precise values of their amplitudes cannot be deduced, except in simple cases, without additional information about their relative phases. The possibility of obtaining this information from optical model calculations is discussed, with reference to proton emission from ^{12}C. There is a difference between the observed angular distributions of protons and neutrons. The ^{12}C results are accounted for in terms of the different effective charges assigned by the hydrodynamic model for electric quadrupole transitions; however, those for ^{16}O cannot be explained in this way. (auth)

31353 (CONF-730301-P2, pp 741-752) RADIATIVE CAPTURE. Suffert, M. (Centre de Recherches Nucleaires, Strasbourg). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

A brief review is given for radiative capture leading into the giant dipole resonance region of 1p- and 2s-1d-shell nuclei. In the 1p-shell nuclei, which are the most extensively studied by radiative capture, the general behavior of the excitation curves and angular distributions is emphasized. The determination of absolute cross sections, the radiative capture leading to excited states in the final nucleus and the radiative capture of composite particles are examined in some detail. The situation in the 2s-1d-shell nuclei is only sketched. (auth)

31354 (CONF-730301-P2, pp 755-779) POLARIZATION EFFECTS IN THE GIANT DIPOLE RESONANCE. Glavish, H. F. (Stanford Univ., CA). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

Studies of the nuclear giant dipole resonance by observing polarization effects in the nucleon channel of proton capture and photoneutron reactions are reported and discussed. These studies, when combined with the results of unpolarized angular distribution measurements, provide a more detailed description of the E1 configuration in a giant dipole resonance, and therefore a more exhaustive test of present theoretical models. In addition they are expected to play an important role in establishing the existence or otherwise of configurations in the giant dipole resonance which are not of an E1 nature. (auth)

31355 (CONF-730301-P2, pp 885-886) QUASI-ELASTIC SCATTERING (e,e'd) AND (e,e'p) FROM ^{6}Li. Heimlich, F. H. (Univ., Freiburg i B.); Roessle, E.; Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D.; Bienlein, J. K.; Bleckwenn, J.; Dinter, H. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31356 (CONF-730301-P2, pp 887-888) ELECTROEXCITATION OF ^{11}B. Fleming, D. M. (Univ. of Massachusetts, Amherst); Kan, P. T.; Peterson, G. A.; Webb, D. V.; Fivozinsky, S. P.; Lightbody, J. W.; Penner, S. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31357 (CONF-730301-P2, pp 889-890) ELASTIC ELECTRON SCATTERING FROM ^{12}C AND THE PROTON, A COMPARISON AND ABSOLUTE CALIBRATION OF THE CROSS SECTIONS. Merle, K. (Univ., Mainz). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31358 (CONF-730301-P2, pp 927-928) INVESTIGATION OF THE RADIATIVE CAPTURE OF TRITONS BY ^{7}Li. Blatt, S. L.; Suffert, M.; Degre, A.; Schaeffer, M. (Univ. Louis Pasteur, Strasbourg). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31359 (CONF-730301-P2, pp 929-930) RADIATIVE ^{3}He CAPTURE BY ^{9}Be AND STATES AT HIGH EXCITATION IN ^{12}C. Linck, I.; Kraus, L. (Univ. Louis Pasteur, Strasbourg). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31360 (CONF-730301-P2, pp 931-932) OBSERVATION OF HIGH LYING LEVELS IN ^{17}O VIA RADIATIVE CAPTURE OF TRITONS BY ^{14}N. Linck, I.; Kraus, L.; Blatt, S. L. (Univ. Louis Pasteur, Strasbourg). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31361 (CONF-730301-P2, pp 933-934) STUDY OF THE ^{11}B(^{3}He,γ) REACTION FROM $E_{^3He}$ = 1.5 TO 5.8 MeV. Maute, R. E.; Blatt, S. L.; D'Amato, D. P. (Ohio State Univ., Columbus). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31362 (CONF-730301-P2, pp 935-936) ^{13}C(d,γ)^{15}N CROSS SECTION IN THE GIANT DIPOLE REGION OF ^{15}N. Weller, H. R.; Blue, R. A.; Mo, T. (Univ. of Florida, Gainesville). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31363 (CONF-730301-P2, pp 937-938) ^{15}N(p,γ)^{16}O TO EXCITED STATES OF ^{16}O. Lowe, J. (Univ. of Birmingham, Eng.); Chew, S. H.; Nelson, J. M.; Barnett, A. R. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31364 (CONF-730301-P2, pp 939-940) STRUCTURE IN THE ^{16}O GIANT RESONANCE AS SEEN IN ^{15}N(p,γ_0)^{16}O. O'Connell, W. J.; Latshaw, G. L.; Black, J. L.; Hanna, S. S. (Stanford Univ., CA). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31365 (CONF-730301-P2, pp 967-978) EXPERIMENTAL INVESTIGATION OF THE HIGH-ENERGY PHOTODISINTEGRATION OF ^{16}O. Hartmann, H.; Hoffmann, H.; Mecking, B.; Noeldeke, G. (Univ., Bonn). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

The high energy photodisintegration of ^{16}O was investigated with the 500 MeV-synchrotron of the University of Bonn. Using a scintillation counter telescope and a time-of-flight-spectrometer (pn)-, (pp)- and (pd)-coincidences were registered. The data were analyzed assuming that the particles were emitted in a direct reaction. This model fits the (pn)- and the (pd)-data well. The energy dependence of the cross sections is the same as for the free processes ^{2}H(γ,p)n and ^{3}He(γ,p)d. The distributions of the summed momenta of the emitted particles in the nucleus before the reaction are described by shell model calculations with the usual parameters. The (pp)-data cannot be explained with this simple direct reaction model. (auth)

31366 (CONF-730301-P2, pp 981-982) ^{12}C(γ,p)^{11}B REACTION OF E_γ = 60, 80, AND 100 MeV. Matthews, J. L.; Owens, R. O.; Gardiner, S. N.; Findley, D. (Univ. of Glasgow). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31367 (CONF-730301-P2, pp 987-988) ENERGETIC PHOTOPROTONS AS A TOOL FOR STUDYING THE NUCLEON–NUCLEON CORRELATIONS. Malecki, A. (Inst. of Nuclear Physics, Krakow); Picchi, P. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31368 (CONF-730301-P2, pp 989-990) MEASURED CROSS SECTIONS FOR THE DIRECT ^{12}C(γ,n)^{11}C PROCESS (64 MeV $\leq E_\gamma \leq$ 123 MeV). Eyss, H. J. v.; Schier, H.; Schoch, B. (Univ., Mainz). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31369 (CONF-730301-P2, pp 1001) PHOTOPRODUCTION OF ^{24}Na FROM NUCLEI, 12 $\leq$ Z $\leq$ 29. Jaerund, A.; Friberg, B.; Forkman, B. (Lund Inst. of Tech., Sweden). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31370 (CONF-730301-P2, pp 1055-1056) ANGULAR DISTRIBUTION OF PHOTONEUTRONS FROM THE GIANT RESONANCE OF ^{16}O. Syme, D. B. C. B.; Crawford, G. I. (Univ. of Glasgow). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31371 (CONF-730301-P2, pp 1061-1062) (e,e'x) COINCIDENCE EXPERIMENTS ON ^{6}Li, ^{9}Be, AND ^{24}Mg. Julien, J. (CEN de Saclay, Gif-sur-Yvette, France); Samour, C.; Bianchi, G.; Duval, P.; Genin, J. P.; Letourneau, R.; Mougeot, A.; Rambaut, M.; Palmeiri, A.; Vinciguerra, D. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31372 (CONF-730301-P2, pp 1303-1317) INELASTIC ELECTRON SCATTERING AND PARTICLE–HOLE STATES IN NUCLEI. Donnelly, T. W. (Stanford Univ., CA). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The formalism for inelastic electron scattering and excitation of particle-hole states in nuclei is summarized with particular attention paid to what features distinguish electroexcitation from other means of studying the nucleus. It is shown how electron scattering form factors can be used directly to determine one-body densities. Three selected examples are used to illustrate these ideas: ^{12}C which has been extensively studied both experimentally and theoretically, the multiplet of T = 1 states near 13 MeV in ^{16}O and the first excited 0^+ state in ^6Li where in fact wave functions can be empirically determined. Finally the relation between the electromagnetic processes such as electron scattering and weak processes such as β-decay, μ-capture and neutrino reactions are discussed, and it is shown how predictions for weak rates can be made in an essentially model-independent way. (auth)

31373 (CONF-730301-P2, pp 1319-1329) MEDIUM-ENERGY PHOTOREACTIONS. Costa, S. (Istituto Nazionale di Fisica Nucleare, Turin). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Some photonuclear reactions at energies above the giant resonance but below the meson photoproduction threshold are considered. Both experimental and theoretical results on (γ,N) and (γ,np) reactions in light nuclei (except the hydrogen and helium isotopes) are reviewed. The possibility of obtaining information about short range correlations in nuclei is investigated in the light of recent measurements and calculations. (auth)

31374 (ISN-1972, pp 61-63) SELF-CONSISTENT CALCULATION OF NUCLEAR DENSITY USING THE EFFECTIVE MASS APPROXIMATION. Cole, A. J.; Worledge, D. H. 1972. (In French).

Densities of ^{40}Ca and ^{16}O were calculated using a local, momentum-dependent potential whose real central radial form is derived from the density itself and a Yukawa two-body interaction. The effective mass parameter was adjusted to obtain good fits to experimental charge distributions. (auth)

31375 (ORNL-TM-4334) CALCULATED SECONDARY-PARTICLE SPECTRA FROM ALPHA-PARTICLE- AND CARBON-INDUCED NUCLEAR REACTIONS. Gabriel, T. A.; Santoro, R. T.; Bertini, H. W.; Larson, N. M. (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 15p. Dep. NTIS $3.00.

A newly developed calculational model for nucleus–nucleus collisions was applied to obtain secondary-neutron spectra from 100-MeV/nucleon alpha particles incident on ^{12}C and from 100-MeV/nucleon ^{12}C incident on ^{12}C. These data can be used in estimating shielding requirements for medium-energy heavy-ion machines. Also included is a comparison between a previous model used only for calculating secondary-particle spectra from alpha-particle nuclear reactions and the new, more general nucleus–nucleus collision model. (4 figures, 1 table) (auth)

31376 INVESTIGATIONS OF RESONANCES BY MEANS OF REACTION CALCULATIONS IN THE CLUSTER MODEL. Clement, D.; Kanellopoulos, E. J.; Kramer, P.; Schranner, R.; Teufel, A. G.; Wildermuth, K. (Univ., Tuebingen, Ger.). (1973). vp. (In German).

From Spring meeting of the Deutsche Physikalische Gesellschaft Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

By means of two-channel calculations within the framework of the cluster model, a description is given for the two $5/2^-$ resonances of the mirror nuclei ^7Li and ^7Be. The characteristic differences in resonance width and phase behavior of the two nuclei are largely reproduced. In model calculations for ^7Li, the effect on the S matrix of the cluster structure of resonances which are located in energy slightly above the threshold of the second channel is studied. The phase behavior and the reaction cross section show strong variations as a function of the energy of such a resonance if it has essentially the structure of the second channel. For resonances with a cluster structure of the first channel, only a relatively weak dependence has been found. This different behavior can be interpreted as a consequence of the penetration effect. As a further example, model calculations for the $3/2^+$ resonance of ^5He are presented; in this case also the energy location of the resonance relative to the d–t threshold has a strong influence on the phase behavior and the reaction cross section. Cases with more than two open channels can be considered to be similar to those mentioned above. (13 figures) (tr-auth)

31377 MICROSCOPIC DESCRIPTION OF THE DENSITY DEPENDENT FORCES IN ^{16}O. Tripathi, R. K.; Muether, H.; Faessler, A. (Kernforschungsanlage, Juelich, Ger.). (1973). vp.

From Spring meeting of the Deutsche Physikalische Gesellschaft. Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

Fully self-consistent Brueckner–Hartree–Fock (BHF) calculations are done for ^{16}O in an attempt to explain the density dependence of the forces microscopically. A variational principle is also invoked. This gives rise to the occupation probability and a new rearrangement term which was not considered in BHF calculations done so far. Both the Pauli operator and the starting energies are made self-consistent. The Yale force was used for the calculations. (2 figures, 1 table) (auth)

31378 ELASTIC AND INELASTIC SCATTERING OF ^{16}O BY ^{12}C AT FORWARD AND BACKWARD ANGLES. Gutbrod, H. H.; Bock, R.; von Oertzen, W.; Schlotthauer-Voos, U. C. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Phys.; 262: No. 5, 377-392(1973).

Angular distributions of the reactions $^{12}C(^{16}O, ^{16}O)^{12}C$ and $^{12}C(^{16}O, ^{12}C)^{16}O$ have been measured in the angular range of $\theta_{CM} = 10^0-60^0$ at 65 and 80 MeV to ground states and excited states of both final nuclei. An optical model with l-dependent imaginary potential gives no consistent description of the elastic scattering data. It is shown, however, that the forward angle elastic scattering may be described by strongly absorbing potentials and that the backward rise of the cross sections in both the elastic and inelastic transitions can be explained by a four-nucleon transfer $^{12}C(^{16}O, ^{12}C)^{16}O$. (11 figures, 3 tables) (auth)

31379 PRODUCTION RATES OF HYPERFRAGMENTS AND CRYPTOFRAGMENTS FROM Σ^- CAPTURES. Goel, S. P. (Kurukshetra Univ., India); Prakash, Y. Nuovo Cim.; 17A: No. 3, 434-442(1 Oct 1973).

The capture of Σ^--hyperons in the emulsion nuclei is studied through computer simulation using the Monte Carlo technique. The production rates of hyperfragments and cryptofragments obtained from experimental work in nuclear emulsion seem to be underestimated in the light of the information obtained from the simulated results. Corrections to the experimental results are made. Additional criteria to estimate the rate of formation of cryptofragments are suggested. (auth)

31380 QUASIELASTIC HIGH ENERGY ELECTRON SCATTERING ON LIGHT NUCLEI. Kuplennikov, E. L.; Afanas'ev, N. G.; Gol'dshtein, V. A.; Ogurtsov, V. I.; Vlasenko, V. G. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 18: No. 1, 20-23(Jul 1973). (In Russian).

Results are presented of study of the quasielastic electron scattering at the incident energy of 1184 MeV, in the angle interval 26 to 31°, on light nuclei. To interprete the experimental data the one-particle shell model with the oscillator potential, as well as the Fermi-gas model, were used. Absolute cross sections, the oscillator parameters, the Fermi momenta are obtained. The momentum transfer dependence of the mean nucleon binding energy is also found in the interval $q \sim 280$ to 600 MeV/c. (auth)

31381 ELASTIC SCATTERING OF DEUTERONS BY ^{14}C FROM E_d = 4 TO 10 MeV. Cole, W. S. (Univ. of Florida, Gainesville); Mo, T.; Weller, H. R.; Ramirez, J. J. Nucl. Phys.; A213: No. 1, 107-116(1973).

Angular distributions for the elastic scattering of deuterons by ^{14}C were measured at nine energies between E_d = 4.2 and 10 MeV. Excitation functions were taken in 50 keV steps from E_d = 4 to 10 MeV. A resonance was observed at E_d = 4.5 MeV, which corresponds to an excitation energy of 14.41 MeV in ^{15}N. An analysis using an optical model plus a single-level formula derived from the R-matrix formalism yields an l-value assignment of l = 4 for this resonance. Of the three J^π values allowed for l = 4 ($J^\pi = 3^+$, 4^+, 5^+), the value of $J^\pi = 3^+$ is found to be slightly preferred. Possible identification of this resonance with an analog in ^{15}O is discussed. The angular distributions measured at off-resonance energies were analyzed with an optical-model potential which has a surface-peaked imaginary well. The energy dependence of the real and imaginary well depths is explicitly determined for E_d = 4 to 10 MeV. The best-fit optical-model parameters obtained from the study are compared to those from the $^{14}N(d,d)^{14}N$ work. (auth)

31382 ABSOLUTE POLARIZATION OF NEUTRONS FROM N–^{12}C SCATTERING. Holt, R. J.; Firk, F. W. K.; Nath, R.; Schultz, H. L. (Yale Univ., New Haven). Nucl. Phys.; A213: No. 1, 147-172(1973).

The neutron double-scattering technique was used to study the polarization of neutrons elastically scattered from carbon-12 at eight angles between 20 and 150° in the energy range 2 to 5 MeV. The neutron energies were determined with the nanosecond neutron time-of-flight spectrometer associated with the Yale Electron

Linear Accelerator. The primary intense flux of unpolarized neutrons was generated by the photodisintegration of natural uranium and lead. The neutron spin precession method was used to reduce systematic errors to negligible amounts. The measured polarizations were analyzed using a general, R-function reaction theory and, from this, the neutron total and differential cross sections were predicted. (auth)

31383 $^{12}C(^{7}Li,\alpha)^{15}N$ TRITON TRANSFER REACTION. Tserruya, I. (Technion–Israel Inst. of Tech., Haifa); Rosner, B.; Bethge, K. Nucl. Phys.; A213: No. 1, 22-34(1973).

The $^{12}C(^{7}Li,\alpha)$ reaction was studied up to 16 MeV excitation energy in ^{15}N. Excitation functions for eight α-groups were measured in the 28 to 38 MeV incident energy range. A high resolution angular distribution was taken at $E_{^{7}Li}$ = 35 MeV with the aid of a multi-gap magnetic spectrograph. The contribution of the compound nucleus channel to the α-intensities was estimated. A finite range DWBA calculation in which the three transferred nucleons enter the sd shell was attempted. Results of the above-mentioned studies and the strong selectivity of the reaction indicate a predominant direct reaction mechanism at the present relatively high bombarding energy. Comparison between the experimental results and calculations based on the weak coupling model of Lie and Engeland, exhibit reasonable correlation between the strongly excited states in the present study and the 3p–4h model states for which the contribution of the core excitation is small, and this gives a possible interpretation of the high selectivity of the reaction. (auth)

31384 STUDY OF α + d AND ^{3}He + t CLUSTERING IN ^{6}Li WITH A TWO-MODE, FINITE-RANGE ANALYSIS OF THE $^{6}Li(p,^{3}He)^{4}He$ REACTION. Werby, M. F.; Greenfield, M. B., Kemper, K. W.; McShan, D. L.; Edwards, S. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C, 8: No. 1, 106-113 (July 1973).

The $^{6}Li(p, ^{3}He)^{4}He$ reaction was studied at incident proton energies of 12, 14, and 16 MeV. Detection of both the ^{3}He and ^{4}He particles in the lab defined angular distributions from about 10 to 170 ° c.m. The data taken as well as existing data at 8, 10, and 18.5 MeV were analyzed using a finite-range multi-interaction distorted-wave Born-approximation formalism to determine the importance of clustering in the ^{6}Li nucleus as well as the importance of various reaction mechanisms. Reduced widths of 0.69 for α + d in a relative s state, 0.04 for α + d in a relative d state, and 0.44 for ^{3}He + t in a relative s state provided fits to the data at 12, 14, 16, and 18.5 MeV. (auth)

31385 LOW-q^2 ELECTRON SCATTERING FROM THE 15.109-MeV STATE OF ^{12}C AND THE CONSERVED-VECTOR-CURRENT TEST. Chertok, B. T.; Sheffield, C. (The American University, Washington, D. C. 20016); Lightbody, J. W. Jr.; Penner, S.; Blum, D. Phys. Rev. C, 8: No. 1, 23-36 (July 1973).

High-precision electron scattering measurements from the 15.109-MeV 1^+ state in ^{12}C are made at θ = 75 and 110 ° with $35 \leq E \leq 55$ MeV. From the measurements B(M1) is extrapolated to the photon point and the radiative width is determined, $\Gamma_\gamma = 37.0 \pm 1.1$ eV. The corresponding weak magnetism results for β decay and μ capture are given. (auth)

31386 HIGH-MOMENTUM-TRANSFER ELECTRON SCATTERING FROM ^{6}Li IN A DEFORMED CLUSTER MODEL. Raphael, R.B. (Emory University, Atlanta, Georgia 30322). Phys. Rev. C 8: No. 1, 269-281 (July 1973).

A simplified version of the α–d cluster formalism developed by Neudatchin, Smirnov, and their collaborators gives good agreement with the most recent elastic and inelastic (2.189–MeV) electron scattering data of Li et al. for momentum transfer $q^2 \lesssim 6.5$ fm^{-2}. Inclusion of lowest-order effects of dynamical volume deformations of the intercluster density extends the agreement to $q^2 \lesssim 10.5$ fm^{-2}. The contribution of the latter to the elastic form factor may be interpreted as due to an effective spherically symmetric "modulating charge" distribution superimposed upon the smoothly varying distribution responsible for the scattering at lower momentum transfer. This modulating charge is calculated explicitly and exhibits an oscillatory behavior. A similar analysis is carried out in the inelastic channel. (auth)

31387 INELASTIC SCATTERING OF ^{12}C ON ^{12}C. Wieland, R.; Gobbi, A.; Chua, L.; Sachs, M.W.; Shapira, D.; Stokstad, R.; Bromley, D.A. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. C 8: No. 1, 37-45 (July 1973).

The elastic and inelastic scattering channels in the $^{12}C+^{12}C$ interaction have been measured for the angles θ_{lab} = 15.5°–50.5° over the energy range E_{lab} = 40–60 MeV in steps of 1° and 500 keV, respectively. The strength of the single and mutual excitation of the first excited state (4.43 MeV, 2^+) in ^{12}C was found to be comparable in magnitude to that of the elastic channel over the entire range of the measurement. The implications for the need of coupled-channel analysis of certain heavy-ion scattering systems are discussed, and comparisons between the predictions of certain coupled-channel reaction models and the data are presented. (auth)

31388 TOTAL NEUTRON YIELDS FROM THE PROTON BOMBARDMENT OF $^{17,18}O$. Bair, J.K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 8: No. 1, 120-123 (July 1973).

The $^{17}O(p, n)^{17}F$ reaction has been observed for the first time in the energy region from threshold to 5 MeV. Total neutron-production cross sections measured with good resolution are given. The reaction threshold is determined to be 3743 ± 6 keV. High-resolution total neutron cross sections are also given for the reaction $^{18}O(p, n)^{18}F$ from threshold to 4 MeV. (auth)

31389 SOME NUCLEAR LIFETIMES IN ^{16}O, ^{18}F, AND ^{20}F. Warburton, E.K.; Gorodetzky, P. (Brookhaven National Laboratory, Upton, New York 11973); Becker, J.A. Phys. Rev. C 8: No. 1, 418-419 (July 1973).

The Doppler-shift attenuation method was used in conjunction with ^{16}O and ^{18}O bombardment of tritium targets to measure the mean lives of five levels in ^{16}O, ^{18}F, and ^{20}F. The results are [nucleus, E_x(keV), τ (psec)]: [^{16}O, 3632, 1.45 ± 0.25]; [^{18}F, 1701, 1.16 ± 0.12]; [^{20}F, 984, 2.30 ± 0.25]; [^{20}F, 1309, 1.45 ± 0.25]; and [^{20}F, 1971, 1.40 ± 0.40]. (auth)

31390 CLUSTER-MODEL VERTEX FUNCTIONS FOR ^{16}O: FORWARD α-PARTICLE SCATTERING. Coelho, H.T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania, 19104). Phys. Rev. C 8: No. 1, 93-99 (July 1973).

We show by direct calculation that the lowest-order triangle Feynman diagram model of forward elastic α-particle scattering, together with the assumption of α-cluster structure of ^{16}O and ^{12}C, is capable of explaining the forward angular distribution of the differential cross section in elastic α scattering from ^{16}O. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 31328, 31344, 31353, 31354, 31369, 31371, 31375, 31425, 31434, 31451, 31464, 31486, 31538, 31543, 31554, 31578, and 31615.

31391 (CONF-730301-P1, pp 169-170) DE-EXCITATION X RAYS FOLLOWING PHOTODISINTEGRATION OF ^{31}P. Zalcman, L.; Thomson, J. E. M.; Thompson, M. N. (Univ. of Melbourne, Parkville, Australia). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A high-resolution measurement was made of the de-excitation γ rays from residual nuclei following the photodisintegration of ^{31}P. The experiment used 30-MeV betatron bremsstrahlung and a Ge(Li) detector placed at 125° to the beam. The recorded spectra are shown along with the integrated cross sections. (LTW)

31392 (CONF-730301-P1, pp 171-172) PHOTODISINTEGRATION OF PHOSPHORUS. Gellie, R. W.; Lokan, K. H.; Sherman, N. K. (National Research Council, Ottawa). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The photodisintegration of ^{31}P leading to neutron emission was studied using TOF and an electron linear accelerator. Photoneutron energy distributions were obtained at 90° from a red phosphorus target with a resolution of 0.4 μsec/m. The bremsstrahlung end-point energy was increased in 1-MeV steps from 15 to 25 MeV. The $^{31}P(\gamma,n)$ differential cross section was deduced. The integrated (γ,n) cross section is also shown and compared with other workers. (LTW)

31393 (CONF-730301-P1, pp 173-174) PHOTONEUTRON CROSS SECTIONS IN ^{32}S. Lokan, K. H. (National Research Council, Ottawa); Sherman, N. K.; Gellie, R. W.; Jury, J. W.; Lodge, J. I.; Johnson, R. G. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A detailed study was made of the photodisintegration of ^{32}S leading to neutron emission. Photoneutron energy spectra from a natural sulfur target were obtained at 90° by TOF with a resolution of 0.2 to 0.3 nsec/m. The bremsstrahlung end-point energy

was increased in 2-MeV steps from 16 to 32 MeV. The ^{32}S differential and total cross sections at 90° were deduced as well as the integrated partial cross sections. (LTW)

31394 (CONF-730301-P1, pp 301-302) ROLE OF VALENCE NEUTRON TRANSITIONS IN THE (γ,n) AND (n,γ) REACTIONS. Mughabghab, S. F. (Brookhaven National Lab., Upton, NY). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Partial radiative widths due to p-wave neutron capture in the 83-keV resonance of ^{24}Mg are calculated in the framework of the valence neutron model. (LTW)

31395 (CONF-730301-P1, pp 525-535) STRUCTURE IN THE GIANT RESONANCE: THE LATEST FROM SACLAY. Bergere, R.; Beil, H.; Carlos, P.; Lepretre, A.; Veyssiere, A. (CEN de Saclay, Gif-sur-Yvette, France). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Photoneutron cross sections were measured with monochromatic photons. For s-d shell nuclei $\sigma(\gamma,pn)$ is shown to be much more important than $\sigma(\gamma,n)$ for T = 0 and T = ½ nuclei whereas a clear similarity was observed in the structures of ^{27}Al and ^{28}Si, ^{31}P and ^{32}S, ^{39}K and ^{40}Ca. The evolution of the shape of the giant resonance is studied for Mo isotopes and in the transition region of Sm isotopes. The shape of the giant resonance of Sn isotopes is in agreement with the dynamic collective model. (auth)

31396 (CONF-730301-P1, pp 697-698) DECAY MODES OF THE LOWEST 1^+, T = 1 STATES IN ^{20}Ne AND ^{24}Mg. Kuhlmann, E.; Mamis, A.; Riess, F. (Univ., Freiburg i. B.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The $O^+/2^+$ branching ratios of the lowest 1^+, T = 1 states in ^{20}Ne and ^{24}Mg were measured using the reactions $^{19}F(d,n\gamma)$ and $^{23}Na(d,n\gamma)$ at bombarding energy between 1.9 and 4.0 MeV. A reduced $O^+/2^+$ branching ratio of the lowest 1^+, T = 1 level in ^{20}Ne at $E_x = 11252 \pm 2$ KeV of $R = 0.53 \pm 0.07$ agrees well with the prediction of the rotational model but disagrees with the shell model calculation. The reduced $O^+/2^+$ branching ratio of the lowest 1^+, T = 1 level in ^{24}Mg at $E_x = 9963 \pm 3$ keV of $R = 0.44 \pm 0.20$ agrees within error with the predictions of the rotational model and with other values. A reduced $O^+/2^+$ branching ratio of $R = 0.6^{+2.9}_{-0.3}$ was estimated for the 10.703-MeV level in ^{24}Mg. (LTW)

31397 (CONF-730301-P1, pp 705-706) MONOPOLE FORM FACTORS IN ^{20}Ne. Cong, K. F.; Tomusiak, E. L. (Univ. of Saskatchewan, Saskatoon). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A model for a ^{20}Ne ground state and a 0^+ excited state was constructed. The resulting form factor was fitted to the 6.72-MeV transition. (LTW)

31398 (CONF-730301-P2, pp 803-815) (γ,n) AND (γ,γ) REACTIONS BELOW THE GIANT RESONANCE. Lane, A. M. (Atomic Energy Research Establishment, Harwell, Eng.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The behavior of the E1 strength-function in the vicinity of the neutron threshold is discussed. Most attention is given to nuclei where there is an excess of strength over the giant dipole resonance tail. Usually an excess is observed to be associated with correlations and other nonstatistical effects, which are well described by the simple "valence" model. To explain why this model works raises two grave theoretical problems: accounting for "maverick" valence transitions which retain their E1 strength in the face of the 90% loss by typical particle transitions to the giant dipole resonance, and explaining why particle transitions in the presence of excited target states are apparently much less effective contributors to partial E1 widths than those involving the target ground state — the problem of the "silent majority". Attempts to resolve these problems are reviewed. Recent novel data are also mentioned. (auth)

31399 (CONF-730301-P2, pp 893-894) NUCLEAR CHARGE DENSITY DIFFERENCE OF THE ISOTONES ^{31}P AND ^{32}S FROM ELASTIC ELECTRON SCATTERING. Merle, K. (Univ., Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31400 (CONF-730301-P2, pp 899-908) RADIATIVE CAPTURE EXPERIMENTS. Segel, R. E. (Argonne National Lab., IL). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The results of radiative-capture experiments reported to date are reviewed briefly, and several unsolved problems are pointed out. Unpublished data presented show that the observed variations in the γ-ray angular distributions for ^{28}Si are associated with the fine structure and not with any intermediate structure. In connection with a brief review of α capture, it is noted that anomalously high capture cross sections are observed in the self-conjugate nuclei. Previously unreported data obtained by proton capture in the Fe isotopes show that in the reactions both to ^{57}Co and to ^{55}Co the two isospin components appear to have significantly different angular distributions. The review closes with a discussion of what are considered to be the outstanding unanswered questions. (auth)

31401 (CONF-730301-P2, pp 941-942) ^{40}Ca GIANT DIPOLE RESONANCE EXCITED BY α-CAPTURE. Branford, D.; Black, J. L.; Watson, R. B.; Caelli, W. J. (Australian National Univ., Canberra). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31402 (CONF-730301-P2, pp 953-954) (n,γ) REACTION IN THE GIANT RESONANCE REGION. Rigaud, F. (CEN de Bordeaux, Gradignan, France); Irigaray, J. L.; Petit, G. Y.; Longo, G.; Saporetti, F. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31403 MEASUREMENT OF MULTIPOLE MIXING IN NUCLEAR RADIATION BY A NEW METHOD. Glavish, H.F.; Avida, R.; Hanna, S.S. ; Diener, E.; Boyd, R.N.; Chang, C.C. (Department of Physics, Stanford University, Stanford, California, 94305). Phys. Rev. Lett. 30: No. 9, 391-394 (26 Feb 1973).

The multipole mixing in the 3^+(5.22 MeV) → 2^+(1.369 MeV) transition in ^{24}Mg has been determined by a method based on observing the asymmetry in the radiation emitted from a state which is oriented by a reaction initiated with a vector polarized beam. The particular reaction employed was $^{24}Mg(p,p')^{24}Mg(3^+)$. (auth)

31404 T-INVARIANCE IN NUCLEAR ELECTROMAGNETIC TRANSITIONS. Bulgakov, M. I.; Gul'ko, A. D.; Danilyan, G. V.; Karpikhin, I. L.; Krupchitskii, P. A.; Novitskii, V. V.; Oratovskii, Yu. A.; Pavlov, V. S.; Tarkovskii, E. I.; Trostin, S. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 1, 12-19(Jul 1973). (In Russian).

A T-noninvariant angular γ correlation in the cascade 7.79 to 0.79 MeV, accompanying the capture of slow polarized neutrons by the ^{35}Cl nuclei, was measured in view of the CP-violation observed in the two-pion decay of the K_2^0 meson. The measured asymmetry is found to be $(-0.9 \pm 1.1) \cdot 10^{-4}$, so for the relative phase of the reduced matrix elements in the mixed transition one obtained $\sin \eta = (-1.8 \pm 2.2) \cdot 10^{-3}$. (auth)

31405 γ-RAY DECAY OF LEVELS IN ^{30}S. Kuhlmann, E.; Albrecht, W.; Hoffmann, A. (Univ., Freiburg i. B.). Nucl. Phys.; A213: No. 1, 82-96(1973).

The $^{28}Si(^3He,n)$ reaction was used to investigate the low lying levels of ^{30}S. From n-γ coincidence experiments levels were found at energies of 2211, 3403, 3668, 3676 and 5136 keV. Via DSAM the lifetimes of these levels were determined. The spin of the 3676 keV state was found to be J = 1. (auth)

31406 β^+ DECAY OF ^{20}Na. Torgerson, D. F.; Wien, K.; Fares, Y.; Oakey, N. S.; Macfarlane, R. D.; Lanford, W. A. (Department of Chemistry and Cyclotron Institute, Texas A and M University, College Station, Texas 77843). Phys. Rev. C; 8: No. 1, 161-167(Jul 1973).

The decay scheme of ^{20}Na has been studied in detail to obtain information on the β-decay mirror symmetry properties of the mass-20 multiplet and to determine the Fermi decay strength to the T = 1 isobaric analog state in ^{20}Ne. The ratio ft^+/ft^- was determined to be 1.026 ± 0.024 for the β^+ transitions to the first excited state of ^{20}Ne. The ft value for the transition to the T = 1, 10.278-MeV level was measured to be 2992 ± 233 sec indicating that most of the Fermi strength is concentrated in this transition. A weak γ transition from the 2^+ isobaric analog state to the 2^+ first excited state of ^{20}Ne was observed and new β^+-delayed α groups are reported at 3.27, 5.272, and 5.701 MeV. Theoretical ft values derived from the shell-model wave functions are compared with experiment. (auth)

31407 PHOTOPRODUCTION OF POSITIVE PIONS FROM ^{27}Al AND ^{51}V. Devanathan, V. (International Centre for Theoretical

Physics, Trieste, Italy); Prasad, G.N.S.; Rao, K.S. Phys. Rev. C 8: No. 1, 188-191 (July 1973).

The reactions $^{27}Al(\gamma,\pi^+)^{27}Mg$ and $^{51}V(\gamma,\pi^+)^{51}Ti$ are studied using the free-nucleon photopion production amplitude and the shell model for the nucleus. Numerical calculations are done assuming surface production of pions and the results are compared with the available experimental data. (auth)

31408 PHOTON-INDUCED FRAGMENTATION IN ^{27}Al AND ^{32}S BY 1-GeV BREMSSTRAHLUNG. di Napoli, V.; Salvetti, F.; Terranova, M.L. (Istituto di Chimica Generale e Inorganica, Università di Roma, Roma, Italy); de Carvalho, H.G.; Martins, J.B. Phys. Rev. C 8: No. 1, 206-209 (July 1973).

Polyethylene, water, lithium fluoride, aluminium, and sulphur targets have been irradiated with 1-GeV bremsstrahlung beams at the Frascati electron synchrotron and the yields of some spallation products from ^{27}Al and ^{32}S and of ^{11}C and ^{7}Be from ^{12}C, ^{16}O, ^{19}F, ^{27}Al, and ^{32}S have been measured by the induced-activity and radiochemical methods. Evidence has been deduced for fragmentation from the mass-yield distribution of the photoproduced nuclides in ^{27}Al and ^{32}S. (auth)

31409 LARGE ISOBARIC-SPIN SELECTION-RULE VIOLATION IN THE $^{20}Ne(d,\alpha)^{18}F$ REACTION. Hrejsa, A. F.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 8: No. 1, 230-240 (July 1973).

Absolute differential cross sections were measured at 125 ° with $6 \leq E_d \leq 11$ MeV for the $^{20}Ne(d,\alpha)^{18}F$ reaction leading to the 1.70-, 2.10-, 2.52-, 3.06-, 3.13-, and 3.36-MeV states of ^{18}F and at 45 ° with $5 \leq E_d \leq 13$ MeV for the 2.52-, 3.06-, and 3.13-MeV states. Angular distributions were measured at 6.66, 7.29, 7.93, and 12.95 MeV for the 2.52-, 3.06-, 3.13-, 3.36-, and 4.12-MeV states and at the three lower energies for the 2.10-MeV state. Uncertainties for the isolated states are 3.4%; for the 3.13-MeV state, 5.7%; and for the 3.06-MeV state, 5.7 to 20.2%. The ratio of the cross section for the forbidden reaction to the 3.06, 2^+, T = 1 state to the cross sections for the other five (T = 0) states ranges from 6 to 40% with an average of 21%. The reaction appears to proceed through the compound nucleus. The large violation is discussed in terms of mixing in the compound nucleus and final-state impurity. (auth)

31410 PROTON SCATTERING ON ^{29}Si IN THE RANGE E_p = 2.5-3.4 MeV. Hemsky, J. W.; Ling, S. C.; Wolfe, P. J. (Department of Physics, Wright State University, Dayton, Ohio 45431). Phys. Rev. C, 8: No. 1, 192-199 (Jul 1973).

Elastic and inelastic proton scattering measurements on ^{29}Si have been obtained in the energy range E_p = 2.5-3.4 MeV. 30 elastic and 32 inelastic resonances were observed. 14 prominent resonances from elastic scattering were analyzed. Results of the analysis for proton orbital momenta, spin and parity assignments, and proton partial widths are given. The inelastic resonance strengths measured relative to the known strength of the 1302-keV resonance in $^{29}Si(p,\gamma)^{30}P$ are also reported. (auth)

31411 ISOBARIC MASS QUARTETS IN THE MASS-21 AND MASS-37 NUCLEI. Benenson, W.; Kashy, E.; Proctor, I.D. (Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 8: No. 1, 210-215 (July 1973).

The $^{40}Ca(^3He, ^6He)^{37}Ca$ reaction has been used to measure the mass of ^{37}Ca in its ground and first excited states. The mass of ^{37}Ar and ^{37}K in their lowest T = 3/2 states was also measured. The $^{24}Mg(^3He, ^6He)^{21}Mg$ reaction was used as a calibration, and consequently the energies of several excited states of ^{21}Mg were measured. The mass-37 measurements give new precision values for the coefficients of the isobaric multiplet mass equation, and the excited states in ^{21}Mg are members of quartets in the mass-21 nuclei. (auth)

31412 INVESTIGATION OF THE LOWEST T = 2 STATE OF ^{32}S IN THE ^{31}P + p REACTIONS. Vernotte, J.; Gales, S.; Langevin, M.; Maison, J. M. (Institut de Physique Nucléaire, B. P. n° 1, 91406-Orsay, France). Phys. Rev. C; 8: No. 1, 178-187 (Jul 1973).

Two resonances have been observed at 3.283 ± 0.003 and 3.289 ± 0.003 MeV in the $^{31}P(p,\gamma)^{32}S$ reaction. The corresponding excitation energies are 12.044 ± 0.004 and 12.050 ± 0.004 MeV. The γ-decay schemes and resonance strengths have been measured. On the basis of γ-ray angular-distribution and proton elastic scattering measurements the 12.044-MeV level has been assigned J^π,T = 4⁻,1. The 12.050-MeV level has been assigned J = 0 from γ-ray angular-distribution and correlation measurements. A proton elastic scattering experiment has yielded an upper limit of 230 eV for the total width of the 12.050-MeV level. This state is shown to be the lowest J^π,T = 0^+,2 state in ^{32}S. (auth)

31413 SHELL-MODEL STUDY OF ^{24}Ne. Robertson, R.G.H.; Wildenthal, B.H. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 8: No. 1, 241-246 (July 1973).

Shell-model calculations for the A = 24, T = 2 system are presented which use an empirically modified version of Kuo's realistic two-body interaction and a large, but truncated, sd-shell basis space. Using the same two-body matrix elements, single-particle energies and effective charges that were found to be successful in the full sd space for A = 19-22, good agreement with experimental measurements is obtained for ^{24}Ne levels and other members of the A = 24, T = 2 system. Some predictions are made for the unreported isotope ^{24}Si. (auth)

31414 β^+-DELAYED-PROTON DECAY OF ^{21}Mg. Sextro, R.G.; Gough, R.A.; Cerny, J. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 8: No. 1, 258-268 (July 1973).

Identified protons with energies from 900 keV to 6.3 MeV have been observed following the positron decay of ^{21}Mg. The half-life of ^{21}Mg was measured to be 123.1 ± 3.3 msec, which, combined with previous results, gives a best value of 122.5 ± 2.8 msec. The energies and intensities of the proton groups have been used to determine precise excited state energies in ^{21}Na above 5 MeV and the strength of the preceding β^+ transition feeding each level. These data, and the assumption of isospin purity for the lowest T = 3/2 level in ^{21}Na, then yield absolute ft values for the beta decay. The ^{21}Mg transition rates compared with the negatron decay rates in its mirror, ^{21}F, give $(ft)^+/(ft)^- = 1.10 \pm 0.08$. All significant particle decays of the lowest T = 3/2 level have been observed, including an upper limit on energetically possible, but unobserved, α decay. The measured transition strengths were compared to recent shell model calculations for β decay in the s-d shell. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 31239, 31328, 31374, 31395, 31398, 31400, 31401, 31407, 31451, 31486, 31554, 31605, 31608, and 31624-31626.

31415 (CONF-730301-P1, pp 179-180) RESULTS ON ELASTIC 180° SCATTERING FROM ^{45}Sc, ^{51}V, ^{55}Mn, AND ^{59}Co. de Vries, H.; Lapikas, L.; Box, G.; van Niftrik, G. J. C. (Inst. for Nuclear Physics Research, Amsterdam). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The results of magnetic scattering from ^{45}Sc, ^{51}V, ^{55}Mn, and ^{59}Co, all of which have an unpaired proton in the $1F_{\frac{7}{2}}$ shell, are reported. The results for the oscillator parameter b and the corresponding single-particle octupole moment $\Omega_{s.p.}$ [$\Omega_{s.p.} = 3.79 \times {}^9/_2\, b^2\, \mu_n$] are tabulated for several combinations of the gyromagnetic ratios g_l and g_s. (LTW)

31416 (CONF-730301-P1, pp 183-184) ELASTIC ELECTRON SCATTERING ON ISOTOPES OF THE ELEMENTS Fe, Co, Ni, Cu, AND Zn. Andresen, H.; Fricke, G.; Schwentker, O.; Wohlfahrt, H. D. (Univ., Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The following cross section ratios vs. angle for 150-MeV electrons are shown: $\sigma(^{60}Ni)/\sigma(^{56}Fe)$; $\sigma(^{64}Zn)/\sigma(^{60}Ni)$; $\sigma(^{66}Zn)/\sigma(^{62}Ni)$. Results of an analysis of 150-, 250-, and 275-MeV electron scattering data using a Fermi 3-parameter charge distribution are tabulated for ^{54}Fe, ^{56}Fe, ^{58}Ni, ^{60}Ni, ^{62}Ni, ^{64}Ni, ^{65}Cu, ^{64}Zn, ^{66}Zn, ^{68}Zn, and ^{70}Zn. (LTW)

31417 (CONF-730301-P1, pp 297-298) ELECTROMAGNETIC DECAY OF FRAGMENTED ANALOG STATES. Mitchell, G. E. (North Carolina State Univ., Raleigh); Wimpey, J. F.; Bilpuch, E. G.; Peters, W. C. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Preliminary results are reported for decay of analog states of ^{54}Cr, ^{58}Fe, and ^{62}Ni. (LTW)

31418 (CONF-730301-P1, pp 537-538) EXPERIMENTAL STUDY OF THE PHOTONUCLEAR GIANT RESONANCE IN ^{40}Ca. Brajnik, D.; Jamnik, D.; Kernel, G.; Miklavzic, U.; Stanovnik, A. (Institut Jozef Stefan, Ljubljana, Yugoslavia). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The cross sections and angular distributions of the $^{40}Ca(\gamma,p)$ reaction were measured. (LTW)

31419 (CONF-730301-P1, pp 541-542) PHOTONEUTRON CROSS SECTION OF ^{45}Sc. Sambell, R. H.; Spicer, B. M. (Univ. of Melbourne, Parkville, Australia). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The total photoneutron cross section for ^{44}Sc was measured from threshold to 25 MeV, including the (γ,n), (γ,np), and (γ,2n) processes. (LTW)

31420 (CONF-730301-P1, pp 543-544) STUDY OF THE STRUCTURE IN THE GIANT RESONANCE OF ^{55}Mn. Van de Vyver, R. E.; Carchon, R.; Devos, J.; Van Deynse, C.; Ferdinande, M. (Rijksuniversiteit, Ghent). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The total photonuclear cross section of ^{55}Mn was measured from threshold to 23 MeV (where the influence of the (γ,2n) reactions is still relatively unimportant) with good energy resolution to examine the splitting of the dipole resonance and to search for additional fine structure in the leading edge of the giant resonance. (LTW)

31421 (CONF-730301-P1, 545-546) PHOTONEUTRON CROSS SECTIONS FOR ^{55}Mn. Alvarez, R. A.; Berman, B. L.; Lewis, F. H.; Meyer, P. (Univ. of California, Livermore). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The photoneutron cross sections of ^{55}Mn were measured with approximately 100-keV energy resolution using nearly monoenergetic photons. The photon energy varied from 10 to 37 MeV. The total photoneutron cross section and the (γ,2n) and (γ,3n) cross sections are shown. (LTW)

31422 (CONF-730301-P1, pp 549-550) PHOTONEUTRON CROSS SECTIONS FOR ^{58}Ni. Fultz, S. C.; Alvarez, R. A.; Berman, B. L.; Meyer, P. (Univ. of California, Livermore). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The photoneutron reaction of ^{58}Ni was measured with high resolution using nearly monoenergetic photons and an enriched target (99.89%). The photon energy resolution varied smoothly from about 50 keV at 10 MeV to approximately 90 keV at 35 MeV. (LTW)

31423 (CONF-730301-P1, pp 553-554) PHOTOPROTON REACTIONS OF Ni ISOTOPES. Miyase, H.; Oikawa, S.; Suzuki, A.; Uegaki, J.; Saito, T.; Sugawara, M.; Shoda, K. (Tohoku Univ., Sendai). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
The isospin splitting of the giant dipole resonance in ^{58}Ni, ^{60}Ni, and ^{62}Ni was investigated by the (e,e'p) reactions. The (γ,p), (γ,p_0) cross sections and angular distributions are studied. (auth)

31424 (CONF-730301-P1, pp 675-683) GIANT RESONANCES OTHER THAN E1. Torizuka, Y.; Kojima, Y.; Saito, T.; Itoh, K.; Nakada, A.; Mitsunobu, S.; Nagao, M.; Hosoyama, K.; Fukuda, S.; Miura, H. (Tohoku Univ., Sendai). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
Inelastic electron scattering experiments in the giant resonance regions of ^{44}Ca, ^{56}Fe, ^{90}Zr, and ^{208}Pb were carried out. The cross section spectra up to 35 MeV in excitation energy were obtained at the momentum transfers between 0.4 and 1.0 fm^{-1}. Evidence for quadrupole (or monopole) giant resonances which exhaust most part of the energy-weighted sum rule was obtained from the analysis of the experimental form factor. (auth)

31425 (CONF-730301-P2, pp 817-831) THRESHOLD PHOTONEUTRON MEASUREMENTS. Jackson, H. E. (Argonne National Lab., IL). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
Developments in the study of photoneutron spectra in the resolved-resonance region near threshold are discussed with emphasis on the information they give on the photonuclear reaction mechanism. Results for electric dipole photoabsorption suggest nuclear structure effects in the form of intermediate structure and partial width correlations for nuclei with $A \lesssim 50$ and for nuclei near closed shells. Intense p-wave photoneutron emission by the Pb isotopes indicates the presence of a magnetic dipole giant resonance whose integrated strength is close to the theoretical limit; evidence for a similar phenomenon in the Sn isotopes is contradictory. Intermediate structure of a different character is observed in M1 photoabsorption by ^{57}Fe. Information on significant nonresonant (γ,n) reactions is also reviewed. (auth)

31426 (CONF-730301-P2, pp 943-944) ALPHA CAPTURE TO THE GIANT DIPOLE RESONANCES OF T = 2 NUCLEI. Branford, D.; Foote, G. S.; Bell, R. A. I.; Weisser, D. C.; Huang, F. C. P.; Watson, R. B. (Australian National Univ., Canberra). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31427 (CONF-730301-P2, pp 945-946) RADIATIVE CAPTURE OF FAST NEUTRONS BY ^{40}Ca. Bergqvist, I. (Univ. of Lund, Sweden); Drake, D.; McDaniels, D. K. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31428 (CONF-730301-P2, pp 947-948) DISPLACEMENTS OF STRUCTURE IN CAPTURE PHOTON SPECTRA FOR NEIGHBORING TARGET NUCLEI. Drake, D. M. (Los Alamos Scientific Lab., NM); Halpern, I. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31429 (CONF-730301-P2, pp 983-984) PHOTONUCLEAR REACTIONS IN ^{55}Mn BETWEEN 300 MeV AND 1000 MeV. de Carvalho, H. G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Martins, J. B.; Tavares, O. A. P.; di Napoli, V.; Salvetti, F. 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31430 (CONF-730301-P2, pp 995-996) CROSS SECTIONS AND ISOMERIC YIELD RATIOS IN THE PRODUCTION OF ^{44}Sc FROM HEAVIER NUCLEI. Eriksson, M.; Jonsson, G. G. (Lund Inst. of Tech., Sweden). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31431 (CONF-730301-P2, pp 1069-1070) ROLE OF SIMPLE CONFIGURATIONS IN THE γ DECAY OF THE CAPTURE STATE IN THE (n,γ) REACTIONS. Knat'ko, V. A.; Rudak, E. A. (Inst. of Physics, Minsk). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.

31432 (CONF-730301-P2, pp 1095-1105) PHOTONUCLEAR REACTIONS IN REACTORS. Francis, N. C.; Lubert, M.; Mendelson, M. R. (Knolls Atomic Power Lab., Schenectady, NY). 1973.
From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).
In photonuclear reactions and applications.
A variety of reactor photonuclear applications are discussed. ^{2}H and ^{9}Be photoneutrons produced by γ-rays emitted by decaying fission products are discussed. ^{2}H and ^{13}C photoneutron production in $(CH_2)^n$ in γ-ray and neutron attenuation configurations are considered. The production of pure ^{238}Pu in the reflector region of a heavy-water reactor depends on the undesirable ^{237}Np(γ,n) reaction rate. Minimizing the unwanted ^{236}Pu production is briefly discussed. The photoneutron cross sections of ^{53}Cr, ^{61}Ni and ^{57}Fe are investigated in an effort to obtain channel and compound nucleus parameters with which to calculate the ^{52}Cr, ^{60}Ni and ^{56}Fe neutron resonance radiative widths. Modification of the shape of the resonances due to interference effects is considered for ^{56}Fe. The calculated ^{60}Ni and ^{52}Cr thermal cross sections are in good agreement with experiment. (10 figures, 4 tables) (auth)

31433 (DEMO-73/5) EVEN PARITY SPECTRUM OF ^{44}Ca. Skouras, L. D. (Democritus Nuclear Research Center, Athens (Greece)). Jul 1973. 66p. Dep. NTIS (U.S. Sales Only) $5.50.
An extended model allowing for the mixing between 4p spherical and 6p−2h deformed configurations is introduced for the interpretation of the even-parity spectrum of ^{44}Ca. Six intrinsic 6p−2h configurations are considered in the calculation. However, the dependence of the low-lying states of ^{44}Ca on other deformed configurations, not considered explicitly in the calculation, is also examined through the use of an effective parameter. The theoretical results are found to be in good agreement with experiment on both energy levels and transition rates. (4 figures, 7 tables) (auth)

31434 (ISN-1972, pp 39-42) (d,^{6}Li) REACTIONS. Martin, P.; Viano, J. B.; Le Chalony, Y.; Loiseaux, J. M. 1972. (In French).
The (d,^{6}Li) reactions were induced on ^{40}Ca, ^{42}Ca, ^{56}Fe, and ^{58}Ni targets using an incident energy of 28 MeV, and on ^{56}Fe and ^{114}Sn using an incident energy of 36.2 Mev. Excited levels were observed

up to 5–6 MeV and angular distributions were obtained between 10 and 60 deg (lab system). Relative spectroscopic factors were derived from a zero-range DWBA calculation. (auth)

31435 STUDIES ON NUCLEI OF THE 1p SHELL IN THE REGION OF N = 28 WITH THE REACTION (^{3}He,n). Busse, W.; Fuchs, H.; Finckh, E.; Grabisch, K.; Hilscher, D.; Hsu, T. H.; Jahnke, U.; Kluge, H.; Masterson, T. G. (Hahn–Meitner-Institut fuer Kernforschung, Berlin). (1973). vp. (In German).

From Spring meeting of the Deutsche Physikalische Gesellschaft. Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

Two-proton-transfer reactions were investigated on nuclei of the 1p shell in the region of the closed shell at N = 28. The angular distributions of the (^{3}He,n) reaction on Be^9, B^{10}, $C^{12,13,14}$, N^{14} were measured, as well as on Ca^{48}, $Ti^{48,50}$, $Cr^{50,52}$ and Fe^{54}, with a time-of-flight spectrometer with 10 or 13 MeV bombarding energy. The results are analyzed using DWBA calculations, and are compared with the Bohr and Nathan statements on the pairing-vibration model. (GE)

31436 (α,n) REACTIONS WITH ^{40}Ca, ^{44}Ca, ^{40}Ar, ^{16}O, AND ^{14}N. Fitz, W. (Univ., Hamburg); Kienle, F.; Maschuw, R.; Zeitnitz, B.; Scobel, W.; Eberhard, K. A. (1973). vp. (In German).

From Spring meeting of the Deutsche Physikalische Gesellschaft. Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

The (α,n) reactions with ^{14}N, ^{16}O, ^{40}Ar and ^{40,44}Ca have been investigated. The results are discussed in the framework of the optical model. (10 figures, 1 table) (GE)

31437 ELECTRON AND PROTON INELASTIC SCATTERING FROM ^{40}Ca, ^{120}Sn, AND ^{208}Pb. Hammerstein, G. R. (Michigan State Univ., East Lansing); Howell, R. H.; Petrovich, F. Nucl. Phys.; A213: No. 1, 45-60(1973).

Theoretical (e,e') form factors and (p,p') differential cross sections for the first 3^- and 5^- excitations in ^{40}Ca, the first 3^- excitation in ^{208}Pb, and the first 2^+ and 3^- excitations in ^{120}Sn are presented and compared with experiment. Results are also presented which test the hypothesis that the proton and neutron transition densities for these transitions are related by the condition $\rho_n = (N/Z)\rho_p$. A simple modified Born approximation was used in the electron scattering calculations. The long range part of the Kallio-Kolltveit potential was used for the projectile-target interaction in the proton scattering calculations and "knock-on" exchange contributions were included approximately. (auth)

31438 DOUBLE GAMMA DECAY IN ^{40}Ca. Beardsworth, E.; Hensler, R.; Tape, J.W.; Benczer-Koller, N.; Darcey, W. (Physics Department, Rutgers University, New Brunswick, New Jersey 08903); MacDonald, J.R. Phys. Rev. C 8: No. 1, 216-229 (July 1973).

A positive indication of double γ decay in ^{40}Ca may have been observed. A branching ration $\Gamma_{\gamma\gamma}/\Gamma = (3.3^{+0.5}_{-1.2}) \times 10^{-4}$ is reported for the decay of the 3.35-MeV 0_2^+ state. The state was preferentially populated by the (p,p') reaction at a bombarding energy of 5.08 MeV, through a resonance in the compound nucleus ^{41}Sc. Recoil particles were detected in an annular detector at 180°, and γ rays were detected in two NaI(Tl) detectors at 45 ° and 135 ° with respect to the beam axis. Triple time coincidence was demanded of the three radiations, and γ-energy signals were event recorded, together with coincidence information, permitting subsequent generation of two-dimensional energy spectra ($E_{\gamma 1}$ vs $E_{\gamma 2}$) for real, correlated random, and random coincidences. The distribution of double-γ events was analyzed by the maximum-likelihood technique and was found to be consistent with the assumption of (E1,E1) multipolarities. A variety of background processes was considered, but none was found likely to account for the observed spectrum. A brief historical review is given, along with a summary of previous experiments which sought to observe double γ decay in ^{40}Ca and other nuclei. Existing theories for the process are examined. (auth)

31439 CALCULATION OF ISOSPIN CENTROIDS IN THE CALCIUM, NICKEL, AND ZIRCONIUM REGIONS. Bansal, R.K.; Shelly, S. (Department of Physics, Panjab University, Chandigarh-160014, India). Phys. Rev. C 8: No. 1, 282-284 (July 1973).

Centroid energies of the residual nuclei from transfer of a single nucleon to $2p_{3/2}$ orbit in calcium-region targets, $2p_{3/2}$ and $1f_{5/2}$ orbits in nickel targets, $1g_{9/2}$ and $2d_{5/2}$ orbits in zirconium targets, have been calculated using the simple relationships connecting energy centroids of a residual nucleus to the residual interaction parameters, $\bar{W}^{T=1}{}_{j1\text{-}j2}$ and $\bar{W}^{T=0}{}_{j1\text{-}j2}$ of the two-body force. The general equations displaying these relationships have been derived using multipole-sum-rule techniques in an earlier paper. A reasonably good agreement between the calculated and experimental centroid energies demonstrates the usefulness of these equations for predicting the energy centroids knowing the residual-effective two-body force, on one hand, and extracting the effective two-body force from the transfer-reaction data, on the other. (auth)

31440 (^{3}He,t) REACTIONS ON ^{54}Fe, ^{58}Ni, AND ^{60}Ni. Rudolph, H.; McGrath, R. L. (Department of Physics, State University of New York, Stony Brook, New York 11790). Phys. Rev. C 8: No. 1, 247-257 (July 1973).

(^{3}He, t) differential cross sections on ^{54}Fe, ^{58}Ni, and ^{60}Ni targets have been studied at 24-MeV incident energy. Triton angular-distribution systematics are suggested by corroborative data from other work. On this basis several tentative spin-parity assignments in the copper isotopes are given. Distorted-wave Born-approximation calculations based on a microscopic effective-interaction model are presented for ^{54}Fe and ^{58}Ni. These are in fair agreement with the data for the ^{54}Co states thought to have $(1f_{7/2})^{-2}$ structure, and for the T = 1 ^{58}Cu states. However, these calculations generally do not yield consistent effective-interaction strengths or correct angular-distribution shapes for the T = 0 ^{58}Cu transitions. Simple two-particle wave functions are used for mass-58 states where the nucleons occupy the $2p_{3/2}$, $1f_{5/2}$, or $2p_{1/2}$ orbitals. (auth)

31441 LIFETIME OF THE 2542-keV LEVEL IN ^{40}K. Griffiths, R.; Alexander, T.K.; Anyas-Weiss, N.; Randolph, W.L.; Szücs, J. (Nuclear Physics Laboratory, Oxford, England). Phys. Rev. C 8: No. 1, 168-171 (July 1973).

By using the recoil-distance method the mean lifetime of the 2542-keV level in ^{40}K has been measured and found to be 1.5 ± 0.2 ns. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 31344, 31379, 31398, 31402, 31415–31417, 31423, 31425, 31426, 31428, 31430–31432, 31439, 31440, 31486, 31488, 31538, 31543, 31554, 31578, and 31593.

31442 (CONF-730301-P1, pp 181-182) ELECTRON SCATTERING FORM FACTORS CALCULATED WITH PARTICLE-CORE AND PARTICLE-PHONON MODELS FOR ^{63}Cu. de Jager, J. L.; Boeker, E. (Vrije Univ., Amsterdam). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Interaction strengths and single-particle energies were obtained for ^{63}Cu using the particle–core and particle–phonon models by fitting energy levels and spectroscopic factors. Form factors calculated from the model parameters are compared with experimental data. (LTW)

31443 (CONF-730301, P1, pp 187-188) CHARGE DISTRIBUTIONS FOR ^{64,66,68,70}Zn. Weiss, M. S.; Wright, R. M. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A detailed phenomenological analysis of charge distributions for ^{64,66,68,70}Zn was made which indicates a departure from the radial $A^{\frac{1}{3}}$ rule. (LTW)

31444 (CONF-730301-P1, pp 189-190) INVESTIGATION OF THE LOW-LYING COLLECTIVE STATES IN ^{64,66,68,70}Zn BY INELASTIC ELECTRON SCATTERING. Neuhausen, R. (Univ., Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Form factors for the transitions to the low-lying states in ^{64,66,68,70}Zn were measured using a 300-MeV electron linear accelerator. The results for ^{64}Zn are shown. (LTW)

31445 (CONF-730301-P1, pp 299-300) THEORETICAL STUDY OF CORRELATIONS IN THE NEUTRON AND γ-CHANNELS FOR CERTAIN 1^- RESONANCES IN ^{90}Y. Ramavataram, S.; Bergeron, J. (Univ., Laval, Quebec). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Resonance structure in the ^{89}Y + n total cross section in the range 1.0 to 1.2 MeV neutron energy has been interpreted in terms of a comprehensive theory of nuclear reactions. The intermediate structure aspect of these resonances is examined further for channel correlations effects. (LTW)

31446 (CONF-730301-P1, pp 547-548) PHOTONEUTRON CROSS SECTIONS FOR ^{59}Co. Alvarez, R. A.; Berman, B. L.; Lewis, F. H.; Meyer, P. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Photoneutron cross sections of ^{59}Co were measured from 10 to 37 MeV using nearly monoenergetic photons. The total photoneutron cross section and the (γ,2n) and (γ,3n) cross sections are shown. (LTW)

31447 (CONF-730301-P1, pp 551-552) PHOTONEUTRON CROSS SECTIONS FOR ^{60}Ni. Fultz, S. C.; Alvarez, R. A.; Berman, B. L.; Meyer, P. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The photoneutron cross section of ^{60}Ni was measured with high resolution from 11 to 34 MeV using nearly monoenergetic annihilation photons and an enriched target (99.79%). (LTW)

31448 (CONF-730301-P1, pp 555-556) MUON CAPTURE FOR THE STUDY OF T > COMPONENTS OF THE GIANT DIPOLE STATES IN N > Z NUCLEI. Nalcioglu, O. (Univ. of Rochester, NY); Rowe, D. J.; Ngo-Trong, C. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The μ^- capture rates in ^{60}Ni were calculated using the open-shell random-phase-approximation wave functions. States at 15.96, 19.13, 20.27, 21.29, and 25.72 were excited. (LTW)

31449 (CONF-730301-P1, pp 559-560) ISOSPIN EFFECTS IN THE DECAY OF THE GIANT DIPOLE STATE OF GERMANIUM. McCarthy, J. J.; Morrison, R. C.; Vander Molen, H. J. (Iowa State Univ. of Sci. and Tech., Ames). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Combined (γ,n), (γ,np), and (γ,p) measurements were made on ^{72}Ge and ^{74}Ge which yielded the giant dipole resonance isospin component energy splitting and relative strengths. (LTW)

31450 (CONF-730301-P1, pp 701-702) THRESHOLD PHOTONEUTRONS FROM ^{87}Sr, ^{91}Zr, ^{97}Mo, AND ^{113}Cd. Winhold, E. J. (Atomic Energy Research Establishment, Harwell, Eng.); Patrick, B. H.; Bowey, E. M.; Gayther, D. B. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The (γ,n_0) cross section for ^{87}Sr, ^{91}Zr, ^{97}Mo, and ^{113}Cd was studied at energies extending several MeV above threshold with a view to exploring the broad energy dependence of the gamma ray absorption cross section in this energy region. The experiment involved time-of-flight measurements (resolution ~3 nsec/meter) on the photoneutrons emitted at 130° to the incident bremsstrahlung. Several broad peaks several hundred keV wide appear in the resultant (γ,n_0) cross sections extracted from these data. These are similar in general appearance to the peaks reported earlier for ^{117}Sn and ^{119}Sn centered at 7.8 MeV. (auth)

31451 (CONF-730301-P2, pp 717-725) EQUATIONS OF MOTION THEORY OF PHOTONUCLEAR REACTIONS. Rowe, D. J. (Univ. of Toronto). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The generalization of the RPA to open-shell nuclei and to nuclei with $J \neq 0$ or $T \neq 0$ ground states is discussed and shown to provide a powerful theoretical tool for the interpretation of a wide range of nuclear reactions. Illustrative examples are given of its application to photonuclear reactions, electron scattering, muon capture and (n,p) reactions, as probes of the giant dipole resonance and its isospin structure. (auth)

31452 (CONF-730301-P2, pp 949-950) RADIATIVE CAPTURE OF ENERGETIC NEUTRONS IN ^{89}Y AND ^{140}Ce. Nilsson, L. (Tandem Accelerator Lab., Uppsala); Lindholm, A.; Bergqvist, I.; Palsson, B.; Eriksson, J. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31453 (CONF-730301-P2, pp 991-992) (γ,γ') REACTION IN ^{89}Y, ^{115}In, AND ^{197}Au AT INTERMEDIATE ENERGIES. Lindgren, K.; Jonsson, G. G.; Forkman, B. (Lund Inst. of Tech., Sweden). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31454 (ISN-1972, pp 67-69) IN-BEAM γ-RAY SPECTROSCOPY OF EVEN ZINC ISOTOPES. Bruandet, J. F.; Agard, M.; Longequeue, J. P.; Tsan Ung Chan. 1972. (In French).

Gamma spectroscopy studies were made of ^{62}Cu, ^{62}Zn, ^{64}Cu, and ^{64}Zn nuclei using a 30-MeV α-particle beam to induce the following compound-nucleus reactions: ^{60}Ni,^{62}Ni(α,npγ)^{62}Cu,^{64}Cu and ^{60}Ni, ^{62}Ni(α,2nγ)^{62}Zn,^{64}Zn. Preliminary results are given for $\gamma-\gamma$ coincidences. (auth)

31455 MEASUREMENTS OF ANGULAR CORRELATIONS OF ^{88}Sr. Hess, A.; Schneider, H. (Univ., Giessen, Ger.). Z. Phys.; 262: No. 3, 231-238(1973). (In German).

The $\gamma\gamma$ and $e^-_{KL}\gamma$ directional correlations have been measured for the (898-1,836) keV cascade in ^{88}Sr following the decay of ^{88}Y. The observed correlation coefficients are $A_{22}(\gamma\gamma) = -0.0784 \pm 0.0042$ and $A_{22}(e^-_{KL}\gamma) = 0.0102 \pm 0.0046$. The $\gamma\gamma$ experiment is consistent with a mixing ratio $\delta(\gamma) = 0.009 \pm 0.005$ for the 898 keV transition. By using the result of the $e^-_{KL}\gamma$ experiment, the most probable value of the ratio of the penetration matrix element to the normal γ-ray matrix element was determined to be $\eta = 0.03 \pm 0.30$, showing a normal conversion process. This penetration parameter agrees with a hindrance factor $H_W(E1) = 2.1 \times 10^{-3}$ for the E1 transition. (5 figures) (auth)

31456 NUCLEAR DATA SHEETS FOR A = 71. Alvar, K. R. (Rutgers — The State Univ., Brunswick, NJ). Nucl. Data, Sect. A; 10: No. 3, 205-239(Sep 1973).

The 1966 version of the Nuclear Data Sheets for A = 71 was revised on the basis of experimental results received before April 1, 1973. Experimental data, arguments for J^π assignments, and detailed level schemes are presented. Problems with conflicting or apparently incorrect experiments are noted throughout the data sheets. Such problems, among others, occur in the ^{71}Ga $\gamma\gamma$ angular-correlation experiments, in the intensity normalization for the ^{71g}Zn decay scheme, and in conflicting l transfers for several levels reported in ^{70}Ge(d,p) and ^{72}Ge(p,d). Many reaction experiments leading to A = 71 isotopes remain to be investigated. For example, the spin of the 157-keV level in ^{71}Zn could be determined by ^{70}Zn(d,p), and the ^{70}Ge(a,t) and ^{70}Ge(d,n) reactions have not been studied. The ^{70}Zn(^{3}He,d) reaction could be studied with the better resolution instruments now available to experimenters. (auth)

31457 PECULIARITIES IN THERMAL NEUTRON CAPTURE BY EVEN-EVEN NUCLEI IN THE REGION A = 60 TO 80. Murzin, A. V. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 18: No. 1, 24-28(Jul 1973). (In Russian).

Probability of an accidental anticorrelation between the reduced neutron and radiative widths for nuclei ^{69}Zn, ^{71}Ge, ^{73}Ge, and ^{81}Se is considered. It is shown that the anticorrelations observed in the thermal neutron capture by the mentioned nuclei are of a nonaccidental nature. (auth)

31458 STRUCTURE OF 3P SIZE RESONANCE IN NEUTRON STRENGTH FUNCTIONS. Sriramachandra Murty, M.; Siddappa, K.; Rama Rao, J. (Andhra Univ., Waltair, India). Nucl. Phys.; A213: No. 1, 35-44(1973).

Neutron capture cross sections of 21 nuclei were determined using the activation technique and an antimony-beryllium photoneutron source. The nuclei were selected in the mass range $60 < A < 140$ so as to cover the 3P size resonance region of neutron strength functions. Using the latest available data on the low energy resonance parameters, the P-wave neutron strength functions of the 21 isotopes are extracted, and found to be in general agreement with similar isotopic values reported previously. The values of experimental P-wave neutron strength functions in the 3P resonance region ($60 < A < 140$) are compared on the one hand with the theoretical predictions of Fiedeldey and Frahn and on the other with those of Buck and Perey. The shape and structure of the 3P size resonance, as revealed experimentally, are found to agree better with the predictions of Fiedeldey and Frahn, who assumed twice the normal spin-orbit force in their calculations. (auth)

31459 EVIDENCE FOR THE ISOSPIN SPLITTING OF THE GIANT DIPOLE RESONANCE IN ^{64}Zn. Yamaguchi, C. (Tokyo Inst. of Tech.). J. Phys. Soc. Jap.; 34: No. 5, 1123-1127(May 1973).

The ^{64}Zn(γ,n)^{63}Zn and ^{64}Zn(γ,np)^{62}Cu reaction cross sections in the giant dipole resonance region have been measured by the half-life separation method using the bremsstrahlung beam from a 29-MeV betatron. The experimental results realize the predicted splitting of the giant dipole resonance into the two isospin components, $T \leq T_0$ and $T \geq T_0 + 1$. The lower-energy component T<, is at 17 MeV; and the higher one, T>, at 25 MeV. The ratio of the relative intensities of the two components is 0.29 ± 0.04. (auth)

31460 SPIN ASSIGNMENTS IN ^{61}Ni FROM THE ^{60}Ni(d,p)^{61}Ni REACTION. Aymar, J. A.; Hiddleston, H. R.; Berners, E. D.; Rollefson, A. A. (Univ. of Notre Dame, IN). Nucl. Phys.; A213: No. 1, 125-133(1973).

Angular distributions of vector analyzing power and differential cross sections were measured for the ^{60}Ni(d,p)^{61}Ni reaction at a deuteron energy of 10 MeV. The observed j-dependence of the vector analyzing power allowed unambiguous spin assignments for the following states in ^{61}Ni (excitation energies in MeV): 0.0, $3/2^-$; 0.068, $5/2^-$; 0.284, $1/2^-$; 1.186, $3/2^-$; 2.701, $5/2^+$. A definitive assignment of $1/2^-$ is made to that member of an unresolved doublet at 2.123 MeV which proceeds by $l_n = 1$ transfer. An assignment of $9/2^+$ is indicated for the member of the doublet which proceeds by $l_n = 4$ transfer. Most of the data are well reproduced by DWBA calculations employing available deuteron and proton optical model parameters. The behavior of the vector analyzing power for the two low lying ^{61}Ni states formed by $l_n = 1$ transfer was measured for angles from 2.5 to 15° using a magnetic spectrograph and found to be in agreement with DWBA predictions. (auth)

31461 ENERGY LEVELS IN ^{76}Se FROM THE DECAY OF ^{76}As. Nagahara, T. (Rikkyo Univ., Yokosuka, Japan). J. Phys. Soc. Jap.; 34: No. 3, 579-587(Mar 1973).

Energy levels of ^{76}Se have been studied from the decay of ^{76}As with a Ge(Li) Compton suppression spectrometer and Ge(Li)–NaI (Tl) and Ge(Li)–Ge(Li) coincidence spectrometers. Directional-correlation measurements have been performed on four cascades with Ge(Li)–NaI(Tl) detector arrangements. Forty-four gamma rays were observed, 43 of them were assigned to a level scheme of ^{76}Se with 16 excited levels. Spin assignments of 2 for the levels at 1216.08 and 1787.64 keV were confirmed. The 657.03-keV transition was a mixture of 97% E2 and 3% M1. The level at 1122.33 keV was definitely determined to have a spin of 0. The spin of the 1688.97-keV level was assigned as 3, and the 1129.30-keV transition was nearly of M1. The 1228.52-keV transition was of a mixture of 53% M1 and 47% E2. (auth)

31462 OPTICAL-MODEL-FAMILY AMBIGUITY RESOLVED FOR ^{3}He ELASTIC SCATTERING FROM ^{60}Ni. Fulmer, C. B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Hafele, J.C. Phys. Rev. C 8: No. 1, 172-177 (July 1973).

Optical-model fits with successive fixed values of real well depth V to five angular distributions for ^{60}Ni(^{3}He,^{3}He)^{60}Ni which include data to angles > 110 ° for projectile energies between 29.6 and 71.1 MeV yield χ^2 vs V plots with a deep minimum at V ≈ 130 MeV for each data set. For the lower-energy data sets, other minima (parameter families) are observed at intervals above and below this value, but the higher-energy data sets (59.8 and 71.1 MeV) show only one unique family near V = 130 MeV. The absence of the family ambiguity for the higher-energy data sets demonstrates the importance of both large-angle and high-energy data for the removal of optical-potential ambiguities. The normalized volume integral of the real potential at V ≈ 130 MeV is $J_R \approx 330$ MeV fm^3 for each data set, and J_R changes by ≈ 100 MeV fm^3 for successive families. The unambiguous value of $J_R \sim 330$ MeV fm^3 for the higher-energy data sets and the near independence of J_R on energy implies a similar unique value and corresponding unique family for the lower-energy data sets. This value of 330 MeV fm^3 is somewhat lower than values of $J_R > 400$ MeV fm^3 suggested by earlier studies. (auth)

31463 ENERGY DEPENDENCE OF THE OPTICAL MODEL FOR ^{3}He SCATTERING FROM ^{60}Ni. Fulmer, C. B.; Hafele, J. C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Foster, C.C. Phys. Rev. C 8: No. 1, 200-205 (July 1973).

An optical-model analysis of measured angular distributions for elastic scattering of ^{3}He from ^{60}Ni at five different energies (29.6, 35.1, 49.7, 59.8, and 71.1 MeV) produced satisfactory fits to all five of the data sets with an optical potential having all parameters common. This energy independent potential gave a χ^2 minimum with V = 126 MeV, $r_R = r_s = 1.12$ fm, $a_R = a_s = 0.84$ fm, $W_D = 20.4$ MeV, $r_I = 1.26$ fm, $a_I = 0.84$ fm, and $V_s = 2.85$ MeV. Another parameter family with V = 170 MeV also gave an equally good minimum in χ^2. These two parameter families were used to predict scattering cross sections at 180 ° over the ^{3}He energy range from 21 to 32 MeV, and corresponding laboratory data were found to be in better agreement with the predictions of the above listed family with V = 126 MeV. Slightly improved fits to the five data sets were obtained in a search with the real and imaginary well depths dependent on ^{3}He energy and with the rest of the parameters common. In this case V and W_D were found to have a weak but approximately linear dependence on ^{3}He energy E, with V = 133.9–0.14E MeV and W_D = 22.4–0.04E MeV. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 31293, 31354, 31375, 31379, 31395, 31398, 31402, 31424, 31425, 31431, 31434, 31437, 31439, 31445, 31450, 31452, 31453, 31458, 31519, 31538, 31543, 31546, 31554, 31632, 31633, and 31905.

31464 (BNL-18235) TABLES OF ANGULAR DISTRIBUTION COEFFICIENTS FOR GAMMA RAYS OF MIXED MULTIPOLARITIES EMITTED BY ALIGNED NUCLEI. der Mateosian, E.; Sunyar, A. W. (Brookhaven National Lab., Upton, N. Y.). Sep 1973. 135p. Dep. NTIS $8.75.

Tables of angular distribution coefficients were calculated for gamma rays of mixed multipolarities emitted by aligned nuclei in transitions between states of both integer spins and half-integer spins. (2 figures, 2 tables) (auth)

31465 (CONF-710947-P2, pp 655-658) ESTIMATION OF ^{125}Te NUCLEAR RADIUS CHANGE IN 35.48-keV MOESSBAUER γ TRANSITION. Makaryunas, K.; Kalinauskas, R.; Davidonis, R. (Inst. of Physics and Mathematics, Vilnyus, USSR). 1971. (In Russian).

From 4th international conference of the socialist countries on Moessbauer spectrometry; Dresden, F. R. Germany (20 Sep 1971).

Results obtained by other authors concerning the effect of chemical binding on internal conversion in the valence shell and data in the literature on the isomer shift were used to estimate the change in radius of the ^{125}Te nucleus in the 35.48-keV transition. (tr-auth)

31466 (CONF-730301-P1, pp 191-192) ISOTOPIC EFFECTS IN ELASTIC ELECTRON SCATTERING ON THE EVEN MOLYBDENUM ISOTOPES. Dreher, B. (Univ., Mainz); Lemb, M.; Lenz, F. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Cross sections for elastic scattering of electrons on the even molybdenum isotopes were measured at incident electron energies of 120, 200, and 274 MeV. The measurements were analyzed by a model-independent method. The model-independent quantities (the mean radius function and the moment function) are given for ^{92}Mo and for the difference in the charge distribution of neighboring isotopes. (LTW)

31467 (CONF-730301-P1, pp 199-200) STUDY OF THE T > GIANT RESONANCE IN ^{142}Nd WITH THE (e,e'p) REACTION. Saito, T.; Oikawa, S.; Shoda, K.; Sugawara, M.; Miyase, H.; Suzuki, A.; Uegaki, J. (Tohoku Univ., Sendai). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The T > giant resonance in ^{142}Nd was investigated by the (e,e'p) reaction. The result of the photoproton cross section is consistent with theoretical prediction based on the isospin splitting of the E1 giant resonance. (auth)

31468 (CONF-730301-P1, pp 303-304) INVESTIGATION OF THE REACTION MECHANISM OF ^{108}Pd(n,γ)^{109}Pd. Mughabghab, S. F.; Kane, W. R.; Casten, R. F. (Brookhaven National Lab., Upton, NY). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Gamma spectra from radiative neutron capture in ^{108}Pd were measured. The spin and parity of the 2.96-eV resonance were found to be $J^\pi = 3/2^-$. A comparison between measured predicted partial radiative widths is made. (LTW)

31469 (CONF-730301-P1, pp 305-306) NUCLEAR RESONANT SCATTERING FROM THE 6730-keV IN ^{120}Sn. Kawarasaki, Y. (Japan Atomic Energy Research Inst., Tokai). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The branching ratios of ^{120}Sn are plotted as a function of excitation energy from 6.8 to 9.0 MeV together with those of other even–even nuclei reported elsewhere. (LTW)

31470 (CONF-730301-P1, pp 307-308) POSSIBILITIES OF PHOTO-EXCITATION OF EVEN–EVEN NUCLEAR ISOMERS. Veres, A.; Pavlicsek, I.; Csueroes, M. (Inst. of Isotopes, Budapest). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Possible isomers of ^{90}Zr, ^{178}Hf, ^{180}Hf, ^{190}Os, and ^{204}Pb were studied using the 1.38 and 2.75 MeV γ rays from ^{24}Na. No measurable isomeric activity was obtained for any of the samples. The upper limits of the activation cross section per primary γ quantum were estimated as 2×10^{-5} μb for ^{90}Zr^m, 10^{-5} μb for ^{180}Hf^m, 2×10^{-4} μb for ^{190}Os^m, and 8×10^{-5} μb for ^{204}Pb^m. (LTW)

31471 (CONF-730301-P1, pp 539-540) SOME NEW EVIDENCE FOR THE ISOSPIN SPLITTING OF THE PHOTONUCLEAR GIANT RESONANCE IN ^{90}Zr. Brajnik, D.; Jamnik, D.; Kernel, G.; Korun,

M.; Miklavzic, U.; Pucelj, B.; Stanovnik, A. (Institut Jozef Stefan, Ljubljana, Yugoslavia). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Several photonuclear reactions in ^{90}Zr were investigated using bremsstrahlung gamma rays from a 31-MeV betatron. Some preliminary results are presented for the following processes: $^{90}Zr(\gamma,p_0)^{89}Y_{g.s.}$, $^{90}Zr(\gamma,p)^{89}Y_{1-3MeV}$, $^{90}Zr(\gamma,2n)^{88}Zr$, and $^{90}Zr(\gamma,np)^{88}Y$. The cross sections for the first two processes were deduced from the photoproton spectra, while the last two result from the analysis of activation gamma lines. (auth)

31472 (CONF-730301-P1, pp 561-562) SIMILARITIES IN PHOTOPROTON SPECTRA FROM ^{90}Zr AND ^{91}Zr. Askin, H. J. (Univ. of Melbourne, Parkville, Australia); Allen, K. J. F.; Thompson, M. N.; Shoda, K.; Sugawara, M.; Miyase, H.; Sung, B. N. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Recent results are reported that show similarities in the (γ,p), or $(e,e'p)$, spectra from ^{90}Zr and ^{91}Zr. (LTW)

31473 (CONF-730301-P1, pp 563-565) TOTAL PHOTONUCLEAR CROSS SECTIONS FOR Mg AND Nb. Sugiyama, S.; Tomimasu, T. (Electrotechnical Lab., Toyko). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The total photonuclear cross sections for Mg and Nb were measured by means of the attenuation method using a high-efficiency magnetic pair spectrometer combined with two current spark chambers as ladder counters. Results are given for Nb which show a main giant resonance peak with a maximum value of 210 Mb at 16.8 MeV and a 110-Mb peak at 21.5 MeV, which seems to be due to the effect of isospin selection rules on photonuclear absorption. (LTW)

31474 (CONF-730301-P1, pp 699-700) EXCITATION OF THE GIANT MAGNETIC DIPOLE RESONANCE IN ^{90}Zr. Cecil, F. E. (State Univ. of New York, Stony Brook); Fagg, L. W.; Bendel, W. L.; Ensslin, N.; Jones, E. C. Jr. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A self-supporting target of isotopically enriched ^{90}Zr was bombarded with electrons of 37, 50.6, and 60.5 MeV/c incident momentum. A broad peak is seen at an excitation energy of 9.1 MeV. The peak is magnetic dipole in character with a tentative ground-state transition width of 117 ± 23 eV. (LTW)

31475 (CONF-730301-P2) PHOTONUCLEAR REACTIONS AND APPLICATIONS. International Conference, Pacific Grove, California, March 26-30, 1973. Proceedings, Volume II. Berman, B. L. (ed.) (California Univ., Livermore. Lawrence Livermore Lab.). 1973. 678p. Dep. NTIS $27.20 (Vols. 1 and 2).

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

Separate abstracts are prepared for the 95 papers in this volume. For abstracts of papers previously appearing in NSA see CONF-730301 in a cumulative report number index. (CES)

For abstracts of individual papers see: 29575–29584, 29664, 29727, 29768, 30716–30719, 30725, 30726, 30754–30756, 30783, 30872, 31127, 31128, 31134, 31154, 31313–31317, 31352–31373, 31398–31402, 31425–31432, 31451–31453, 31476–31481, 31509, 31510, 31532–31536, 31554, 31600–31606, 31708, 31728, and 31755.

31476 (CONF-730301-P2, pp 783-799) NEUTRON-CAPTURE GAMMA RAYS. Bollinger, L. M. (Argonne National Lab., IL). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A general review is given of the ways in which neutron-capture γ rays are used to study neutron-capture mechanisms and the properties of energetic radiative transitions in heavy nuclei. The statistical properties of radiation widths and some departures from statistical behavior are summarized. The relation of the E1 transitions to the giant dipole resonance is illustrated, and evidence for deviations of the γ-ray strength functions from the Lorentzian shape of the GDR is given. A consideration of the systematics of M1 transitions in heavy nuclides leads to useful numerical relations for the M1 radiation widths. (auth)

31477 (CONF-730301-P2, pp 1049-1052) GIANT RESONANCES AND NUCLEAR STRUCTURE. Sedlmayr, R.; Brand, M.; Rezwani, V.; Greiner, W. (Univ., Frankfurt am Main). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The spectra of some Te, Xe, Ba isotopes are difficult to classify. Rotational bands obeying the I(I + 1) rule do not exist, but on the other hand pure vibrational character has to be also excluded, because the O^+-state is missing in the energy region of the triplet. Often a 3^+-state occurs instead. The γ-absorption and scattering cross section of the above mentioned isotopes were calculated in the framework of dynamic collective model of giant resonances (DGR). Using the potential energy surfaces (PES) and spectra which have been fitted to the experimental data by Habs et al., γ-absorption and scattering cross sections were calculated, and it was shown that these nuclei are very soft with respect to γ-vibrations and behave like typical transitional nuclei. (auth)

31478 (CONF-730301-P2, pp 1053-1054) SEMIPHENOMENOLOGICAL INTERPRETATION OF THE GIANT DIPOLE RESONANCE WIDTH. Carlos, P.; Bergere, R.; Veyssiere, A.; Beil, H.; Lepretre, A.; Miniac, A. (CEN de Saclay, Gif-sur-Yvette, France). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31479 (CONF-730301-P2, pp 1077) MAIN FEATURES OF THE ROME (e,e'p) EXPERIMENT. Campos Venuti, G. (Instituto Superiore di Sanita, Rome); Cortellessa, G.; Farchi, G.; Frullani, S.; Salvadori, P.; Capitani, G. P.; DeSanctis, E.; Takamatsu, K. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31480 (CONF-730301-P2, pp 1201-1224) PHOTONUCLEAR PHYSICS, 1973: WHERE WE ARE AND HOW WE GOT THERE. Fuller, E. G. (National Bureau of Standards, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A brief history is presented of the study of photonuclear reactions from the time of the first measurements in 1934 through the most recent measurements in 1972 and early 1973. Trends are indicated both for the specific types of measurements carried out, as well as for the geographic areas of the world active in the field. A review is given of the data obtained since 1955 as a function of element and isotope and the areas where data are missing are pointed out. Finally, the results of a survey made in early 1973 are given. This survey covered the existing experimental facilities, as well as the research programs directed toward the study of the interaction of electromagnetic radiation with nuclei. (auth)

31481 (CONF-730301-P2, pp 1293-1302) ELECTROEXCITATION OF VIBRATIONAL AND ROTATIONAL NUCLEI. Lightbody, J. W. Jr. (National Bureau of Standards, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Several recent developments in electro-excitation of vibrational and rotational nuclei are discussed, including high momentum transfer studies of collective excitations in spherical nuclei, multi-phonon excitation in terms of the anharmonic vibrator and quasi-particle models, and excitations of ground state and excited state rotational bands. (auth)

31482 (FRNC-R-23) INSTITUT MAX von LAUE–PAUL LANGEVIN ANNUAL PROGRESS REPORT, 1972. (Institut Max von Laue–Paul Langevin, Grenoble (France)). 1972. 149p. (In Several Languages). Dep. NTIS (U. S. Sales Only) $9.50.

The work currently being undertaken at the Institute is reviewed from both theoretical and experimental points of view. The work covers the following disciplines: nuclear physics; properties of pure crystals; magnetic and crystallographic structures; liquids, gases and amorphous substances; imperfections in crystals; physical chemistry, and physical biochemistry. New projects are cited. A list of publications and theses is given. The different phases in the operation of the reactor are recalled. The problems connected with the technical services teams and the scientific support are presented together with a discussion on the administration. (FR)

31483 (FRNC-TH-391) CAPTURE OF LARGE NUMBERS OF NUCLEONS BY RARE EARTH TARGETS IRRADIATED WITH ARGON BEAMS. de Moras, Y. (Paris Univ., Orsay (France)). 1973. 72p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

Thesis.

The following targets were bombarded with ^{40}Ar beams of 257 and 282 MeV: ^{142}Nd, ^{143}Nd, ^{144}Nd, ^{145}Nd, and ^{146}Nd, ^{141}Pr and Ce (natural). The cross sections for the formation of ^{151}Dy, ^{150}Dy and ^{149g}Dy were studied for each of these targets. The formation of these isotopes corresponds to a gain of more than 9 nucleons, at least six of which are protons. It was possible to study the variation of the production cross sections as a function of the number of neutrons or protons gained by the target. The various mechanisms which can intervene in these reactions led to the detailed study of the $^{142}Nd + ^{40}Ar \rightarrow ^{151}Dy$ reaction at 284 MeV for which the angular distribution and residual nucleus recoil paths were measured as a function of the recoil angle. A large number of mechanisms occur during this reaction: capture of 6 protons + 7 or 8 neutrons (predominant mechanism) or capture corresponding to different proportions of protons and neutrons. These captures are accompanied by a high receiver-nucleus energy, which enables 4 or 5 nucleons to be evaporated. The process appears to be a type of partial fusion, implying the significant involvement of the nuclear field. The existence of this strong nuclear interaction during which more than 10 nucleons are interchanged between the nuclei without involving complete fusion is unexpected. (FR)

31484 (ISN-1972, pp 56-57) ELASTIC AND INELASTIC SCATTERING OF 28.6-MeV POLARIZED DEUTERONS BY ^{120}Sn. Perrin, G.; Nguyen Van Sen; Arvieux, J.; Perrin, C.; Darves-Blanc, R.; Durand, J. L.; Fiore, A.; Gondrand, J. C.; Merchez, F. 1972. (In French).

The cross section and the vector and tensor analyzing powers were measured for Sn(d,d$_0$) induced by 28.6-MeV polarized deuterons. The data are analyzed in terms of the optical model including a tensor T_A term in the potential. Cross sections and vector analyzing powers were also measured for the inelastic scattering from the 1.18-MeV (2^+) and 2.44-MeV (3^-) states; the data are analyzed in terms of the coupled-channels formalism. (auth)

31485 (ISN-1972, pp 69-71) STUDY OF RELAXATION PHENOMENA IN INDIUM AS A FUNCTION OF TEMPERATURE. Boudard, A.; De Saintignon, P.; Menet, J.; Loiseaux, J. M. 1972. (In French).

The temperature dependence of the alignment of an isomeric state in ^{117}Sb was studied. Evidence for a quadrupole relaxation mechanism contribution was found. (auth)

31486 (INS-J-142) TABLE OF MEMBERS OF QUASI-GROUND, QUASI-BETA, AND QUASI-GAMMA BANDS. Sakai, M. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 31 Jul 1973. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

For even-even nuclei a list is presented of the probable members of quasi-ground, quasi-beta, and quasi-gamma bands of the spherical regions and the corresponding ground, beta, and gamma bands of the deformed regions. For simplicity the term "quasi" is used for both regions. References are given to the experimental data basic to the level assignments. The literature was covered through July 1973. (1 figure, 1 table, 426 references) (auth)

31487 TRANSITION CHARGE DENSITIES OF THE 2_1^+ AND 2_2^+ STATES IN ^{108}Pd AND ^{114}Cd. Hosoyama, K.; Torizuka, Y.; Kawazoe, Y.; Ui, H. (Laboratory of Nuclear Science and Department of Physics, Tohoku University, Sendai, Japan). Phys. Rev. Lett. 30: No. 9, 388-391 (26 Feb 1973).

We have obtained inelastic electron-scattering 2_1^+ and 2_2^+ form factors in ^{108}Pd and ^{114}Cd in the momentum-transfer range between 0.6 and 1.8 fm^{-1}. The transition charge densities of the 2_1^+ and 2_2^+ levels were extracted from the experimental form factors by assuming a phonon model in which the one- and two-phonon states are mixed. The wave functions (transition charge densities) obtained have been found to describe reasonably the measured 2_1^+ quadrupole moments and the radiative transition rates of the crossover and cascade γ rays. (auth)

31488 STUDIES ON THE ISOSPIN MIXING OF ANALOGUE RESONANCES IN THE REGION OF A = 90. Bauer, J.; Clement, H.; Feist, J.; Graw, G.; Kretschmer, W.; Zoellner, G. (Erlangen-Nuernberg Univ., Ger.). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft. Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

A summarizing report is given on the investigations of analog resonances in the A = 90 region, carried out by using the Erlanger polarized source. The object of the investigations was to distinguish between direct reactions and compound processes such as the problem of isospin mixture with analog resonances. In order to do this, the ground state $d_{5/2}$ analog resonances were measured by the elastic scattering of polarized protons on the target nuclei ^{90}Zr, ^{88}Sr, ^{89}Y, ^{92}Zr. (11 figures, 1 table) (GE)

31489 HALF-LIFE AND GAMMA-RAY ENERGIES OF ^{143}Ba AND ^{144}Ba. Tamai, T.; Takada, J.; Matsushita, R.; Kiso, Y. (Kyoto Univ.). Inorg. Nucl. Chem. Lett.; 9: No. 9, 973-979 (Sep 1973).

It is stated that due to the difficulty of the rapid isolation of Ba from fission products nuclear data have not yet been reported in detail. Although the half-lives of ^{143}Ba and ^{144}Ba have been obtained indirectly from measurement of the activities of their daughter or granddaughter precipitates, the γ-ray energies have hitherto not been reported. The present communication describes measurement of the γ-ray energies, their relative intensities, and the half-lives of these nuclides as separated by paper electrophoresis from irradiated enriched uranyl nitrate solution. Details are given of the experimental work; and results, given and discussed. The half-life of ^{144}Ba was estimated as ~10 S, and that of ^{143}Ba, as ~20 S. The γ-ray energies and their intensities were computer determined and are shown tabulated. (UK)

31490 NUCLEAR DATA SHEETS FOR A = 94. Kocher, D. C. (Oak Ridge National Lab., TN). Nucl. Data, Sect. A; 10: No. 3, 241-308(Sep 1973).

The 1960 version of the Nuclear Data Sheets for A = 94 was revised on the basis of experimental data received prior to April 1, 1973. Information from approximately 165 papers and communications is included in the present evaluation. Nine nuclei are well established for A = 94. Only the presumed ground states and their half-lives are known for ^{94}Kr and ^{94}Rb. The ^{94}Sr decay scheme was recently determined. Some discrepancies are found in the reported decay schemes for ^{94}Y. Many spin assignments for low-lying levels in the stable nuclei ^{94}Zr and ^{94}Mo are firm. Many levels are known in ^{94}Nb, but only a few spin assignments can be made independently of shell-model predictions. The decay schemes for the two ^{94}Tc isomers appear well established. A few firm spin assignments are made for levels in ^{94}Tc and ^{94}Ru. The two known branches in ^{94}Ru decay are found to have unusually low log-ft values (< 4.0). The existence of the nucleus ^{94}Rh has been reported for the first time, but details of the observations are not yet published. (auth)

31491 ENERGY-LEVEL SYSTEMATICS OF ODD-MASS LANTHANUM ISOTOPES; A NEW COUPLING SCHEME. Leigh, J. R.; Nakai, K.; Maier, K. H.; Puehlhofer, F.; Stephens, F. S.; Diamond, R. M. (Univ. of California, Berkeley). Nucl. Phys.; A213: No. 1, 1-21(1973).

Heavy-ion reactions were used to populate states in the odd-A La nuclei (A = 125 → 137). The γ-ray spectra indicate strong population of a band based on the $11/2^-$ state of each isotope. The character of this band indicates a new type of coupling, and can only be explained if the state has a prolate deformation. This is in contrast to earlier suggestions of oblate shapes for these nuclei. (auth)

31492 DELAYED PROTONS FROM ^{109}Te AND THE β-DECAY STRENGTH FUNCTION. Bogdanov, D. D.; Karnaukhov, V. A.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 3-11(Jul 1973). (In Russian).

The excitation functions of the delayed proton emitter ^{109}Te and of the α-emitters produced from ^{96}Ru irradiated by ^{16}O ions were studied. It was concluded that the mass numbers of α-radioactive tellurium isotopes are 109 and 108. The averaged ^{109}Te proton spectrum is analyzed by means of the statistical model of the delayed proton emission. The β^+-decay strength function of ^{109}Te is shown to have a local resonance at about 5 MeV excitation energy of the daughter nucleus. The resonance is interpreted as a trace of a three quasiparticle resonant state with an assumed configuration ($p^{-1}g_{9/2}$, $ng_{9/2}$)$nd_{5/2}$ which does not totally dissolve in compound resonances. (auth)

31493 GAMMA-RAY ENERGIES AND HALF-LIVES OF PRASEODYMIUM-148 AND -149. Ohyoshi, E. (Kumamoto Univ., Japan); Ohyoshi, A.; Tamai, T.; Takemi, H.; Shinagawa, M. J. Nucl. Sci. Technol. (Tokyo); 10: No. 2, 101-105(Feb 1973).

Rapid separation using NTA in paper electromigration was applied to the study of the γ-decay of ^{148}Pr and ^{149}Pr produced in the fission of ^{235}U. The γ-ray spectrum was measured with a high-resolution Ge(Li) detector. The γ transitions found to decay with half-lives shorter than 3 min were of 135, 162, 256, 300, 511, 614, 696, 868, 1,022 and 1,248 keV. Of these, the values of 300 keV, and of 135 and 162 keV were in fair agreement with those reported for ^{145}Pr and ^{149}Pr. The decay plot of the strong photopeak of 300 keV presented good linearity, and the accurate half-life of ^{149}Pr could be determined as 2.30 ± 0.03 min, which is longer than the 1.98 min reported for ^{149}Pr. Similar decay plots of both photopeaks at 135 and 162 keV gave a half-life of 2.9 ± 0.1 min for ^{149}Pr, which again is longer than the reported value of 2.3 min. Other low intensity photopeaks at 256, 696, 868 and 1,022 keV, decaying with half-lives of 2.1 ~ 2.4 min, can possibly be attributed to ^{148}Pr. The γ transitions of

110, 578 and 742 keV reported for ^{149}Pr could not be observed in this experiment. (auth)

31494 ^{100}Mo(t,p)^{102}Mo REACTION AT 15.8 MeV. Takeda, S.; Yamaji, S.; Matsuda, K.; Kohno, I.; Nakanishi, N. (Inst. of Physical and Chemical Research, Yamato, Japan). J. Phys. Soc. Jap.; 34: No. 5, 1115-1122(May 1973).

The excited states of ^{102}Mo from the (t,p) reaction are presented. New energy levels of ^{102}Mo and the angular distributions of protons leading to them are given and compared with a DWBA calculation. Comparing with the additional data of ^{98}Mo(t,p)^{100}Mo and those on the fission fragments by the Berkeley group, ^{102}Mo is shown to have characteristics of a transitional nucleus. A tentative theoretical analysis by the QRPA with Woods–Saxon bound states was performed. The calculated cross-section ratios of the first 2^+ and 3^- states to the ground state are a little smaller than the experimental ratios. (auth)

31495 DECAY OF ^{108m}In. Flanagan, S.; Chapman, R.; Dracoulis, G. D.; Durell, J. L.; Gelletly, W.; Hartley, A. J.; Mo, J. N. (Univ. of Manchester, Eng.). J. Phys., A (London); 6: No. 9, L133-L136(Sep 1973).

The γ rays emitted in the β^+/EC decay of 59 min ^{108m}In and 40 min ^{108}In have been studied with Ge(Li) detectors in singles and coincidence. A decay scheme for ^{108m}In has been established. The results indicate that ^{108m}In has spin and parity 5^+ or 6^+. This is discussed in terms of the j–j coupling model. (auth)

31496 CHARGE DISTRIBUTION FOR ^{133}Xe–^{133}Cs DECAY PROCESS. Nishizawa, K.; Narisada, K.; Teramatsu, H.; Soya, M.; Shinagawa, M. (Osaka Univ.). Shitsuryo Bunseki; 21: No. 1, 45-51(Mar 1973).

Charge distributions of cesium ions following beta and internal conversion decays of ^{133}Xe were investigated both theoretically and experimentally. The calculations were carried out on the assumption that reorganization of the electronic configuration occurred at each successive step in a vacancy-cascade in which Auger and radiative transitions were involved. The electron-shakeoff process following negative beta decay was also incorporated in the calculation. The calculated spectrum was compared favorably with the experimental one, which had been measured with a charge spectrometer. It was found that the vacancy-cascade model which consisted of radiative, Auger, and shakeoff processes, was satisfactory to account for the charge distribution of an atom followed by a nuclear decay. (auth)

31497 ENERGY DIVISION IN π^-–NUCLEUS COLLISIONS AT 1.5 GeV. Butt, J. E.; King, D. T. (Physics Department, The University of Tennessee, Knoxville, Tennessee 37916). Phys. Rev. C, 8: No. 1, 359-365 (July 1973).

The angular distributions and secondary spectra have been determined for protons and charged pions emergent from collisions of 1.5–GeV negative pions with emulsion nuclei. Expressed in terms of numbers of particles per collision, these results are compared to the predictions of the Monte Carlo intranuclear cascade, averaged over the light- and heavy-target nuclei. The charged-pion spectrum is found to be in large disagreement with that calculated. With included observations on neutral-pion emission, the fraction of primary energy carried away by pions is (16 $\pm$ 4) %, where the calculation predicts 48%. Possible reasons for this discrepancy are discussed, and a long-standing question of apparent energy imbalance in these collisions is revived. (auth)

31498 GAMMA CASCADES IN ^{252}Cf SPONTANEOUS FISSION FRAGMENTS. Hopkins, F.F.; White, J.R.; Moore, C.F.; Richard, P. (Center for Nuclear Studies, University of Texas, Austin, Texas 78712). Phys. Rev. C 8: No. 1, 380-390 (July 1973).

A γ-ray–γ-ray coincidence experiment to measure transitions in the spontaneous fission fragments of ^{252}Cf has been performed with a 0.14-cm^3 Ge(Li) detector (full width at half maximum 600 eV at 81 keV) and a 40-cm^3 Ge(Li) detector (full width at half maximum 2.8 keV at 1.33 MeV) in close geometry and repeated in an extended geometry involving shielding of one of the prompt fragments. Several low-energy cascades have been detected which were previously unreported. In addition partial decay schemes for four of the products, ^{105}Mo, ^{109}Ru, ^{111}Ru, and ^{146}La, have been suggested. (auth)

31499 SEARCH FOR A ZERO–PHONON GAMMA–RAY TRANSITION IN ^{106}Pd AND ^{134}Ba. Stelson, P. H.; Raman, S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); McNabb, J.A.; Lide, R.W.; Bingham, C.R. Phys. Rev. C 8: No. 1, 368-374 (July 1973).

The nuclear quadrupole vibrational model allows one–phonon transitions but forbids both two–phonon and zero–phonon transitions. Whereas there exists a large amount of experimental information on the degree of forbiddenness of two–phonon transitions, there is little meaningful information on zero–phonon transitions. We have looked for the zero–phonon transition between the first 4^+ state (between members of the two–phonon triplet) in the vibrational–type nuclei ^{108}Pd and ^{134}Ba. We were not able to detect the zero–phonon γ rays. The limits set on the intensities of these transitions lead to notable degrees of forbiddenness. For ^{108}Pd and ^{134}Ba, respectively, the ratio $B(E2)_{4\to2}/B(E2)_{4\to2'}$ is greater than 80 and 360 (limits based on two standard deviations). For these nuclei the forbiddenness of a zero–phonon transition is at least as large as the forbiddenness of a two–phonon transition. (auth)

31500 MAGNETIC MOMENT AND SPIN OF 6.9–h ^{93}Mo^m. Kaindl, G.; Bacon, F.; Shirley, D.A. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 8: No. 1, 315-319 (July 1973).

Nuclei of ^{93}Mo^m were oriented in an iron lattice at temperatures down to 7 mK. Anisotropic angular distributions were observed for the 263–, 1477–, and 685–keV γ rays. The form of the angular distributions confimed the spin–multipolarity sequence $21/2^+$ (M4) $13/2^+$ (E2) $9/2^+$ (E2) $5/2^+$ for the isomeric decay. Their temperature dependences yielded the nuclear moment. Magnetic resonance measurements [NMR/ON (NMR with oriented nuclei)] were performed, yielding a resonance at 170.5(4) MHz with a 1–kOe external polarizing field present. Comparison of the derived g factor with the moment from anisotropy data establishes the spin of ^{93}Mo^m as 21/2. The final value of the magnetic moment is $|\mu| = 9.21(20)\ \mu_N$, assumed positive, with the error arising almost entirely from the uncertainty in the hyperfine field. Direct–field orientation in a 44–kOe field at 9 mK gave results in rough agreement. The measured moment confirmed the structure of the $21/2^+$ state as $[(\pi g_{9/2})^3; \nu d_{5/2}]_{21/2}$. The derived value of the proton $g_{9/2}$ g factor agrees well with trends in the Z = 40–45 region, but not with the g factor of the 8^+ state in ^{92}Mo. (auth)

31501 VALENCY NEUTRON CAPTURE IN ^{92}Mo(n,γ)^{93}Mo. Wasson, O. A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Slaughter, G. G. Phys. Rev. C, 8: No. 1, 297-314 (July 1973).

Capture γ-ray spectra from the ^{92}Mo(n,γ)^{93}Mo reaction were measured for neutron energies below 100 keV using the 10–m flight path at the Oak Ridge electron linear accelerator. For neutron energies less than 25 keV a total of 23 different s– and p–wave resonances were resolved. The neutron binding energy is 8067.4 $\pm$ 1.5 keV. The partial radiation widths for the 12 highest energy γ rays which populate positive–parity states below 2.5–MeV excitation were deduced and compared to the valency–model predictions of Lane and Lynn. For γ–ray energies less than 6.5 MeV, the average M1 partial radiation width is approximately equal to the average E1 partial radiation width. The reduced transition strengths as defined by Bartholomew for these transitions are $\overline{k}(E1) = (1.2 \pm 0.2) \times 10^{-3}$ and $\overline{k}(M1) = (11.5 \pm 2.3) \times 10^{-3}$. For the 7126–keV transition to the $s_{1/2}$ first excited state the average reduced strength is enhanced by a factor of 5 and 2 for the E1 and M1 transitions, respectively. Nearly 30% of this enhancement for the E1 multipoles is attributed to the valency–model contribution while the remainder is assigned to other processes such as the giant dipole resonance and doorway–state components. The average E2 width for the 8067–keV ground–state γ rays is approximately 10% of the average E1 ground–state width. (auth)

31502 CHANNEL SPIN COMPONENTS OF p–WAVE NEUTRON WIDTHS IN NIOBIUM. Chrien, R.E.; Bhat, M.R.; Cole, G.W. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 8: No. 1, 336-339 (July 1973).

Measurements of the angular distribution of γ rays following p–wave capture in niobium have been made for resonances at 35.8, 42.2, and 94.3 eV. The differential cross section is the sum of the incoherent contributions from each of the possible channel spin states describing capture in those resonances. From the angular distributions, the ratio of neutron widths corresponding to the two channel spin states can be determined. The results are consistent with what is expected from assuming that each channel spin–dependent width independently follows a Porter–Thomas distribution Reactions ^{93}Nb(n,γ_i)^{94}Nb, E_n = 30–100 eV; measured $\sigma_{n\gamma}(E, \Theta)$, Ge(Li); deduced channel spin components Γ_n distribution. (auth)

31503 COMMENT ON M2–E1 MIXING OBSERVED IN (γ,γ') REACTIONS. Moreh, R.; Wolf, A.; Shahal, O. (Nuclear Research Centre–Negev, Beer Sheva, Israel). Phys. Rev. C 8: No. 1, 401-402 (July 1973).

It is shown that the effect of overlapping resonances in the photoexcitation process of a (γ,γ') reaction is very small. The influence of this effect on the angular distributions of the inelastic transitions and hence on the M2/E1 mixing ratios is shown to be negligible. (auth)

31504 EVIDENCE OF A LOW–INTENSITY β^- TRANSITION IN THE DISINTEGRATION OF ^{99}Tc. Legrand, J.; Morel, J. (Laboratoire de Métrologie des Rayonnements Ionisants du Centre d'Etudes Nucléaires de Saclay, 91190 Gif–sur–Yvette, France). Phys. Rev. C 8: No. 1, 366-367 (July 1973).

Evidence of very low–intensity β^- transition in the disintegration of

^{99}Tc has been demonstrated. It leads to an 89-keV excited level of ^{99}Rh. Its intensity is 1.6×10^{-5}. (auth)

31505 LEVELS IN THE TRANSITIONAL NUCLEI ^{106}Ru AND ^{108}Ru. Kaffrell, N.; Trautmann, N.; Herrmann, G. (Institut für Kernchemie der Universität, D-65 Mainz, Germany); Ahrens, H. Phys. Rev. C 8: No. 1, 320-322 (July 1973).

Low-lying levels of ^{106}Ru and ^{108}Ru associated with the β^- decay of 36-sec ^{106}Tc and 5-sec ^{108}Tc have been investigated by measurement of γ singles and γ-γ coincidence spectra. The activities have been produced by thermal-neutron-induced fission of ^{235}U and ^{239}Pu using automated chemical separations of the technetium fraction from the fission product mixture. Excitation energies and γ-ray branching ratios indicate a transitional character between the limits of the vibrational and the rotational models for ^{106}Ru and ^{108}Ru, with some evidence for an asymmetric deformation. (auth)

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Refer also to abstracts 31023, 31344, 31395, 31398, 31470, 31476, 31478, 31481, 31486, 31554, 31561, and 31574.

31506 (CONF-730301-P1, pp 195-196) ISOBARIC ANALOGS IN THE (e,e'p) REACTION OF ^{169}Tm AND ^{181}Ta. Suzuki, A.: Shoda, K.; Sugawara, M.; Saito, T.; Miyase, H.; Oikawa, S.; Uegaki, J. (Tohoku Univ., Sendai). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The (e,e'p) cross sections and energy spectra of ^{169}Tm and ^{181}Ta were measured at 18.0 to 22.0 MeV. The residual states of this reaction through E1 isobaric analog states were studied by the isocromate. The main parts of the residual states on ^{169}Tm concentrate around the ground state and the low-lying excited states (0 to 3.0 MeV). In the case of ^{181}Ta protons strongly leave the residual nucleus in the highly excited states, not in the ground state. These residual states can be fitted with proton particle-hole states and/or neutron particle-hole states. (auth)

31507 (CONF-730301-P1, pp 197-198) PHOTOPROTON REACTION ON ^{181}Ta. Suzuki, A. (Tohoku Univ., Sendai); Shoda, Shoda, K.; Sugawara, M.; Saito, T.; Miyase, H.; Oikawa, S.; Uegaki, J.; Thompson, M. N.; Allen, K. J. F.; Askin, H. J.; Sung, B. N. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The energy distributions of protons from (e,e'p) reaction and the (e,e'p) cross sections on ^{181}Ta were measured. Two large proton groups were found in the proton spectra at $E_e > 20.0$ MeV. The cross section shows a strong resonance at 20.0 MeV which is expected as T > coherent state. The two main proton groups are resulted through this resonance. The modified Nilsson level scheme explained these proton groups well. (auth)

31508 (CONF-730301-P1, pp 309-310) DIRECT CAPTURE STUDIES IN ^{162}Dy(n,γ). Cole, G. W.; Mughabghab, S. F.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Intensity variations ($\sigma_{n\gamma i}/\sigma_{n\gamma}$) of two E1 primary transitions in ^{162}Dy(n,γ) are shown for the direct reaction amplitude $A_i^0 = 0$ and also A_i^0 = best fit value. Only known positive energy resonance parameters are used. (LTW)

31509 (CONF-730301-P2, pp 951-952) RADIATIVE CAPTURE OF FAST NEUTRONS BY DEFORMED NUCLEI. McDaniels, D. K. (Univ. of Oregon, Eugene); Varghese, P.; Bergqvist, I.; Drake, D. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31510 (CONF-730301-P2, pp 1071-1072) ABOUT ANOMALOUS NATURE OF γ-RAYS SPECTRA FROM THE (n,γ) REACTION ON SLOW NEUTRONS WITH NUCLEI A ~ 200. Rudak, E. A.; Khilmanovich, A. M. (Inst. of Physics, Minsk). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31511 (ISN-1972, pp 77-80) ROTATIONAL AND INTRINSIC ^{175}Lu LEVELS. Hjorth, S. A. (Research Inst. for Physics, Stockholm); Andre, S.; Foin, C. 1972. (In French).

Rotational ^{175}Lu levels populated in the ^{176}Yb(p,2n)^{175}Lu reaction were studied together with the de-excitation gamma cascades using γ-γ coincidences, angular distributions, and lifetime measurements. The rotational energy spectra are discussed in terms of the classical rotor model with Coriolis coupling. (auth)

31512 (ISN-1972, pp 81-83) OBSERVATION OF DELAYED γ TRANSITIONS AND LIFETIME MEASUREMENTS USING ON-LINE TECHNIQUES. Andre, S.; Barneoud, D.; Foin, C. 1972. (In French).

On-line lifetime measurements extend the range of application of γ spectroscopy techniques. The experiments developed enabled the existence of delayed levels in ^{169}Tm, ^{174}Lu, ^{175}Lu, and ^{175}Ta to be established. (FR)

31513 g-FACTOR OF THE 2^+ STATE OF ^{180}W AND QUADRUPOLE MOMENT RATIOS OBSERVED FOR ^{180}W AND ^{180}Hf BY THE MOESSBAUER TECHNIQUE. Zioutas, K.; Wolbeck, B.; Perscheid, B. (Univ., Bonn). Z. Phys.; 262: No. 5, 413-424(1973).

By Moessbauer absorption experiments the magnetic hyperfine splitting has been observed for the 2^+ states of ^{180}W and ^{182}W in a tungsten iron alloy (3.6 at %W). Since the g-factor of the 2^+ state of ^{182}W is known, the measured splitting of the ^{182}W line could be used for the calibration of the magnetic hyperfine field; and the measurement with ^{180}W then gave for the unknown $g(2^+)$ factor of ^{180}W $g(2^+)(^{180}W) = 0.260 \pm 0.017$. By the use of a WO_3 absorber the electric quadrupole splittings in the same states were measured. (5 figures, 3 tables) (GE)

31514 ISOMER SHIFTS OF THE 6.2-keV RESONANCE OF ^{181}Ta. Wortmann, G. Munich; Technische Univ. (1971). 50p. (In German).

Thesis.

The isomer shifts have been observed over a range of 15,000 times the natural or 1,500 times the best experimental line widths on the 6.2-keV resonance of Ta-181. These values are well above the previous resolving power obtained in Moessbauer spectroscopy for isomer shift measurements. These were systematically assigned to the host lattices of the transition metals, in which Ta-181 was present as a slight impurity. The sign could be clearly determined; and the order of dimension of quadratic change of the nuclear charge radius, estimated. From the electric quadrupole splitting of the resonance, the ratio of the quadrupole moment of the 6.2-keV level to that of the ground state was found to be $Q_{\frac{1}{2}} / Q_{\frac{1}{2}} = 1.135 \pm 0.005$. From the magnetic dipole splitting, the ratio of the g factors was found to be $g_{\frac{1}{2}} / g_{\frac{1}{2}} = 1.76 \pm 0.02$. (8 figures, 1 table) (GE)

31515 LIFETIMES AND STRUCTURES OF SOME LEVELS ABOVE 1.5 MeV IN ^{168}Yb, ^{164}Er, AND ^{158,160,162}Dy. Charvet, A.; Chery, R.; Duffait, R.; Morgue, M.; Sau, J. (Univ., Lyon, Villeurbanne, France). Nucl. Phys.; A213: No. 1, 117-124(1973).

The following lifetime measurements were performed in ^{168}Yb: 62 ns (7^-, 2222.5 keV), 0.34 ns (6^-, 2111.1 keV), 81.7 ns (5^-, 1998.7 keV), ≤ 0.14 ns (4^+, 2203.8 keV); in ^{164}Er: 23.3 ns (7^-, 1985.0 keV), 0.22 ns (6^-, 1744.4 keV), ≤ 0.08 ns (5^-, 1664.2 keV); in ^{158}Dy: ≤ 0.11 ns (4^+, 1895.3 keV); in ^{160}Dy: 0.18 ns (4^+, 1694.0 keV); in ^{162}Dy: 1.93 ns(5^-, 1485.9 keV). The experimental reduced transition probabilities are discussed in the framework of current nuclear models. (auth)

31516 DECAY OF ^{151}Nd. Seo, T. (Kyoto Univ.); Hayashi, T.; Mitamura, T. J. Phys. Soc. Jap.; 34: No. 6, 1443-1451(Jun 1973).

The level structure of ^{151}Pm has been studied through the measurements of γ- and β-rays from the decay of 12-min ^{151}Nd. Among many excited levels of ^{151}Pm presented in the previous papers, 13 levels have been confirmed and 16 new levels have been introduced. Spin and parity assignments for several levels in the medium- and higher-energy regions are proposed. In the lower-energy region the third members of the 5/2(413) and 3/2(411) bands and in the medium-energy region two members of the 3/2(541) band have been newly detected. (auth)

31517 DECAY OF ^{165m,g}Dy TO LEVELS TO ^{165}Ho. Yamamoto, H.; Kawade, K.; Yoshikawa, K.; Katoh, T. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 34: No. 6, 1676-1684(Jun 1973).

Radioactive sources of ^{165}Dy and ^{165m}Dy were produced by neutron irradiation, and the decay was investigated. Forty gamma-rays were observed in the decay of ^{165}Dy with a Ge(Li) detector and a Ge(Li)-NaI(Tl) coincidence apparatus. New gamma-rays were detected at the energy of 178 and 339 keV in the coincidence spectra. Seven gamma-rays were seen in the decay of ^{165m}Dy. Delayed and prompt coincidence measurements with the 361.8-keV gamma-ray were performed to confirm cascade relations with this gamma-ray. Decay schemes of ^{165}Dy and ^{165m}Dy were proposed on the basis of the present experimental results. (auth)

31518 LIFETIMES FOR LEVELS ABOVE THE "ROTATIONAL PHASE CHANGE" IN ^{158}Er. Ward, D.; Andrews, H. R.; Geiger, J. S.; Graham, R.L. (Atomic Energy of Canada Limited, Physics Division, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada); Sharpey-Schafer, J.F. Phys. Rev. Lett. 30: No. 11, 493-496 (12 Mar 1973).

Recoil-distance decay curves for ground-band transitions in ^{158}Er were measured using a γ-γ coincidence technique and the reaction ^{130}Te(^{32}S,4n)^{158}Er. We find that the mean lifetimes for the 14$^+$, 16$^+$, and 18$^+$ levels are, respectively, 3.0$\pm$0.7, 2.5$\pm$0.9, and <2.2 psec. These results are consistent with the rotational model in spite of the severe "back-bending" of the level spacings. (auth)

31519 SPEKTRY ELEKTROMAGNITNYKH PEREKHODOV I SKHEMY YROVNEI VOZBUZHDAEMYKH PRI ZAKHVATE TEPLOVYKH NEITRONOV YADRAMI IZOTOPOV S A 143-193. (Spectra of Electromagnetic Transitions and Level Schemes Following Thermal Neutron Capture by Nuclides with A 143-193). Prokof'eva, P. T. (ed.). Riga; Izdatel'stvo Zinatne (1973). 112p. (In Russian and English).

There are presented spectra of γ rays and internal conversion electrons which are emitted following thermal-neutron capture by nuclides with A = 143 to 193 having neutron capture cross sections greater than 5 barns. Internal conversion electron spectra were measured using a β spectrograph at a resolution of 0.07 to 0.3%. In addition, the transition multipolarities and level schemes are given for nuclei excited in (n, γ) reactions. (28 figures, 42 tables, 157 references) (auth)

31520 ROTATIONAL BANDS IN ^{168}Tm FROM THE ^{169}Tm(d, t)^{168}Tm REACTION. Kolata, J. J.; Maher, J. V. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 8: No. 1, 285-296 (July 1973).

The ^{169}Tm(d,t)^{168}Tm reaction has been studied at an incident deuteron energy of 17.0 MeV. The excitation energies of more than 55 states up to 1.5 MeV in the residual nucleus were obtained to an accuracy of $\pm$ 0.15%, and the ground-state Q value for the ^{169}Tm(d,t)^{168}Tm reaction was measured to be $Q_0 = -1775 \pm 6$ keV. Differential cross sections were measured at 2.5° intervals from 7.5 $\leq \theta_{lab} \leq$ 45°, and then at 5° intervals for 45 $\leq \theta_{lab} \leq$ 90° for most of these transitions. The resulting angular distributions were found to be well described by distorted-wave calculatons for almost all transitions observed. The l-transfer values deduced for these transitions allowed the assignment of a narrow range of J$^\pi$ values to the corresponding states in ^{168}Tm, independent of arguments based on the Nilsson-model predictions of transition strengths. Several anomalous angular distributions to presumably well-known rotational states which apparently cannot be explained by the distorted-wave calculations are discussed. Spectroscopic factors for all the observed transitions were computed and are compared to the Nilsson-model predictions for low-lying negative-parity bands. Transition-strength anomalies are discussed. Keywords: Measured: ^{168}Tm level energies, σ (θ) for ^{169}Tm(d,t)^{168}Tm at E_d = 17.0 MeV, DWBA analysis deduced l values, spectroscopic factors. Resolution 9 keV is discussed. (auth)

31521 DETERMINATION OF THE STATIC QUADRUPOLE MOMENT OF THE FIRST 2+ STATE IN ^{170}Er BY COULOMB EXCITATION USING ^{81}Br PROJECTILES. Lutz, W.R.; Thomson, J.A.; Scharenberg, R.P.; Larsen, R.D.; Kerr, R.G. (Department of Physics, Purdue University, Lafayette, Indiana 47907). Phys. Rev. C 8: No. 1, 391-397 (July 1973).

In order to cross-check the reorientation effect as a method of determining nuclear quadrupole moments, we have measured the quadrupole moment of the first 2$^+$ state in the "rotational" nucleus ^{170}Er. A ^{81}Br projectile was used to maximize the magnitude of the reorientation effect while reducing higher-state corrections to negligible amounts. We found $Q_{2+} = -1.94 \pm 0.23$ b for the 79-keV 2$^+$ state in ^{170}Er, which is in excellent agreement with the rotational value $|Q_{2+}(\text{rot})| = 2.15 \pm 0.04$ b. (auth)

31522 HALF-LIVES OF ^{179}Hf^{m2} AND ^{177}Lu^m. Chu, Y. Y.; Ward, T.E. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 8: No. 1, 422-422 (July 1973).

The half-lives of ^{179}Hf^{m2} and ^{177}Lu^m were determined to be 24.8 $\pm$ 0.3 and 160.9 $\pm$ 0.3 day respectively, using chemically and isotopically pure sources. The former is significantly lower than the literature value of 29 $\pm$ 1 day and the latter is in excellent agreement with the recent literature value of 161.0 $\pm$ 0.3 day. (auth)

31523 IDENTIFICATION OF ^{184}Hf. Ward, T.E.; Chu, Y.Y.; Cumming, J.B. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 8: No. 1, 340-346 (July 1973).

Hafnium-184 was identified as a product of the irradiations of natural tungsten and enriched ^{186}W with 92- and 200-MeV protons. The activity was produced by the ^{186}W(p, 3p)^{184}Hf reaction. Mass-separated samples of ^{184}Hf were used to study its β and γ decay. Some γ-γ and β-γ coincidence measurements were performed. The following characteristics were observed: half-life, 4.12 $\pm$ 0.05 h; β-ray end-point energies, 1100 $\pm$ 30, 850 $\pm$ 50, and 740 $\pm$ 30 keV; and γ-ray energies, 41.4, 43.9, 47.9, 139.1, 181.0, and 344.9 keV. A decay scheme is proposed for ^{184}Hf based on the experimental data and theoretical predictions for the excited level structure of ^{184}Ta. (auth)

31524 DECAY OF THE 8-MIN ^{157}Sm. Kaffrell, N. (Institut für Kernchemie, Universität Mainz, D-65 Mainz, Germany). Phys. Rev. C 8: No. 1, 414-417 (July 1973).

After the bombardment of enriched ^{160}Gd with 14-MeV neutrons a new 8.0 $\pm$ 0.5-min nuclide has been observed which is assigned to the (n, α) product ^{157}Sm. A total of 14 γ rays has been found following the decay of ^{157}Sm with the strongest peaks at 121.0, 196.4, 197.8, 394.2, and 844.0 keV. A decay scheme for ^{157}Sm is proposed. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 31344, 31398, 31402, 31424, 31425, 31437, 31453, 31464, 31470, 31476, 31478, 31481, 31486, 31510, 31519, 31546, 31554, 31561, 31580, 31599, and 31629.

31525 (CONF-730301-P1, pp 203-204) SHELL-MODEL CALCULATION OF THE TRANSITION CHARGE DENSITY FOR THE REACTION ^{208}Pb(e,e')^{208}Pb(3$^-$). Arita, K. (Aoyama Gakuin Univ., Tokyo); Terasawa, T. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

An improved calculation of the transition charge density for the lowest 3$^-$ state of ^{208}Pb in the reaction ^{208}Pb (e, e') is described. (LTW)

31526 (CONF-730301-P1, pp 209-210) ANGULAR DISTRIBUTION OF PHOTOPROTONS FROM ^{209}Bi. Uegaki, J.; Oikawa, S.; Suzuki, A.; Miyase, H.; Saito, T.; Sugawara, M.; Shoda, K. (Tohoku Univ., Sendai). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The angular distributions of photoprotons were studied with proton spectra and the cross sections of ^{209}Bi(e,e'p). The proton groups at ~11 MeV shows symmetric angular distribution which can be reduced to the IAR. The angular distributions of protons in the higher energy region and even in the region little lower than the lowest IAR show strong asymmetry, which shows interference between E1 and E2 interactions. (auth)

31527 (CONF-730301-P1, pp 311-312) ^{207}Pb(n,γ)^{208}Pb CROSS SECTION AT 24-keV NEUTRON ENERGY. Wasson, O. A.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The ^{207}Pb(n,γ)^{208}Pb cross section was measured at 24 keV to resolve a discrepancy in the cross section as measured by various workers. (LTW)

31528 (CONF-730301-P1, pp 313-314) GAMMA-RAY STRENGTH FUNCTION BELOW 9 MeV IN Pb REGION. Lone, M. A.; Bartholomew, G. A.; Earle, E. D.; Ferguson, A. J.; Knowles, J. W. (Chalk River Nuclear Labs., Ont.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The strength function $f(E_\gamma) = \Gamma_{\gamma 0\lambda}\rho(E_\lambda)E_\gamma^{-3}$ in the giant dipole tail, ~2 < E_γ < ~9 MeV, was extracted for elements 182 < A < 208. Four methods incorporating new results and reanalyzed old data are combined to give a consistent picture of $f(E_\gamma)$ in this region. (auth)

31529 (CONF-730301-P1, pp 315-316) DISTRIBUTION OF DIPOLE STRENGTH IN ^{208}Pb. Khanna, F. C.; Harvey, M. (Chalk River Nuclear Labs., Ont.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The distribution of dipole strength in the 1$^-$ particle-hole spectrum for ^{208}Pb was calculated, and causes of this structure were studied. The 16-neutron and 15-proton particle-hole states were considered. (LTW)

31530 (CONF-730301-P1, pp 317-318) STUDIES OF LEVELS IN $^{206+207+208}$Pb AND ^{209}Bi USING PHOTONS. Swann, C. P. (Bartol Research Foundation, Swarthmore, PA). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The properties of some bound levels of nuclei in the lead region up to about 5 MeV were studied using electron bremsstrahlung as the exciting radiation. The parameters derived include J^π, Γ_0/Γ, $g\Gamma_0^2/\Gamma$, Γ_0, and G. (LTW)

31531 (CONF-730301-P1, pp 707-708) DISTORTION EFFECTS IN QUASIELASTIC (e,e') SCATTERING FROM A HEAVY NUCLEUS. Klawansky, S. (Massachusetts Inst. of Tech., Cambridge). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Results from a harmonic-oscillator plane-wave shell-model calculation of the electron quasielastic cross section of ^{209}Bi are analyzed using the index of refraction method, and it is concluded that electron distortion is important at q = 400 MeV/c. Results are also given for ^{12}C. (LTW)

31532 (CONF-730301-P2, pp 857-869) MODEL DEPENDENCE IN THE SPECIFICATION OF THE NUCLEAR CHARGE DISTRIBUTION OF ^{208}Pb FROM ELASTIC ELECTRON SCATTERING AND MUONIC X RAYS. Negele, J. W. (Massachusetts Inst. of Tech., Cambridge). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Essentially model independent linear constraints are derived which specify the information contained in experimental muonic x-ray transition energies and elastic electron scattering cross sections. However, a density distribution may be obtained from the experimental data only by introducing model assumptions specifying the high Fourier components of the density. An iterative procedure is presented whereby model assumptions are introduced through a theoretically motivated initial density distribution, and the low Fourier components are successively modified to obtain an optimal fit to all available muonic x-ray and electron scattering data. The errors and error correlations implied by the independent statistical errors in the experimental data are expressed in coordinate space. Pseudoexperimental data for ^{208}Pb, generated from a known charge distribution, are used to demonstrate the validity of the procedure. A detailed analysis of experimental data for ^{208}Pb is presented, utilizing electron scattering data at five different energies and six muonic energy levels. The theoretical implications of this work concerning quantum density fluctuations and the possible existence of a central depression are discussed. (auth)

31533 (CONF-730301-P2, pp 993-994) α-PARTICLES FROM ^{197}Au IRRADIATED BY 500-MeV BREMSSTRAHLUNG. Adler, J. O.; Anderson, G.; Gustafsson, H. A. (Univ. of Lund, Sweden). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31534 (CONF-730301-P2, pp 999-1000) CALCULATIONS FOR PHOTON-INDUCED REACTIONS. Andersson, G. (Univ. of Lund, Sweden). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31535 (CONF-730301-P2, pp 1059-1060) PHOTONEUTRON CROSS SECTIONS FOR ^{209}Bi. Kocimski, S. M.; Cook, B. C. (Iowa State Univ. of Sci. and Tech., Ames). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31536 (CONF-730301-P2, pp 1063-1064) ELASTIC ELECTRON SCATTERING FROM $^{206+207+208}$Pb. de Jager, C. W. (Inst. for Nuclear Physics Research, Amsterdam). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31537 (RLO-1759-26) FISSION STUDIES ON ELEMENTS BELOW POLONIUM. Progress Report, January 1–June 30, 1973. Neuzil, E. F. (Western Washington State Coll., Bellinghamp. 1973. Contract AT(45-1)-1759. 8p. Dep. NTIS $3.00.

Work on angular momentum effects in fission, He fission of Tl, and He fission of Hg is briefly mentioned. A budget report is also included. (RWR)

31538 PHOTOPRODUCTION OF HIGH-ENERGY NEUTRONS IN THICK TARGETS BY ELECTRONS IN THE ENERGY RANGE 150 TO 270 MeV. von Eyss, H. J.; Luehrs, G. (Univ., Mainz). Z. Phys.; 262: No. 5, 393-412(1973).

Photoneutron spectra with energies greater than 12 MeV produced by electrons incident on a thick lead target have been measured for primary electron energies between 150 and 266 MeV and at a fixed angle of 90° to the beam axis. Measurements of the neutron yield have furthermore been performed at a primary energy of 234 MeV as a function of target depth for the same lead target and as a function of the mass number for C, Al, Cu, Cd and Pb targets. The results were obtained with three independent neutron detectors: two proton recoil counters and one time-of-flight set-up. The high-energy regions of the spectra are compared with the predictions of the phenomenological quasi-deuteron model and a satisfactory agreement in shape and scale of the spectra is found. Additional high-energy neutrons from pion reabsorption processes were observed at electron energies of 234 and 266 MeV. (11 figures) (auth)

31539 EFFECTS OF DYNAMICAL DEFORMATION FOR INTERACTION OF COMPLEX NUCLEI. Permyakov, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 48-55(Jul 1973). (In Russian).

Reasons are discussed of variations of the strong interaction effective range, r_0^{eff}, extracted from an analysis of differential cross sections for elastic scattering of complex nuclei. It is shown that due to the presence of static quadrupole deformation for nuclei in the considered region, the value of r_0^{eff} varies no more than by 0.5% of its value for the reaction on the double magic nucleus ^{208}Pb. The observed behavior of r_0^{eff} may be explained if one takes into account possible emergence of a dynamical deformation. (auth)

31540 MIXING OF TWO-PARTICLE, TWO-HOLE STATES IN ^{208}Po. Bhatia, T. S.; Canada, T. R. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania, 15213); Barnes, P.D.; Eisenstein, R.; Ellegaard, C.; Romberg, E. Phys. Rev. Lett. 30: No. 11, 496-500 (12 Mar 1973).

States of ^{208}Po up to an excitation energy of 2 MeV have been investigated via the two-neutron pickup reaction ^{210}Po(p,t)^{208}Po. We have extracted angular distributions for the five observed states of ^{208}Po and have made J^π assignments. These states are discussed in terms of the excitation of simple modes observed in ^{206}Pb and ^{210}Po. Matrix elements have been extracted for the interaction between the two-neutron-hole 2^+ excitations and the two-proton-particle 2^+ excitations and compared with simple theoretical estimates. (auth)

31541 ISOMERIC STATES IN LIGHT EVEN Pb ISOTOPES. Djadali, F.; Krien, K.; Naumann, R.A.; Spejewski, E.H. (Joseph Henry Laboratories of Physics). Phys. Rev. C 8: No. 1, 323-329 (July 1973).

Searches for isomers in the μsec range for isotopes $^{194-200}$Pb revealed a new lifetime of $T_{1/2}$ = 10 μsec for the 1541-keV state in ^{194}Pb and confirmed the $T_{1/2}$ = 0.5-μsec and $T_{1/2}$ = 4-μsec half-lives for the 9^- states in ^{200}Pb and ^{198}Pb, respectively. No lifetime in the μsec range was found in ^{196}Pb indicating that the 688.9-keV transition is not of E3 character as proposed before by Chojnacki et al.. Lifetimes of $T_{1/2}$ = 134 $\pm$ 20 nsec and $T_{1/2}$ = 61 $\pm$ 14 nsec for the 5^- and 9^- states in ^{196}Pb were derived form a γ-γ-t coincidence experiment. A possible distortion of time spectra obtained in in-beam experiments is discussed. Experimental B(E2) and B(E3) values are compared with single-particle estimates for some possible two-neutron configurations of the states involved. (auth)

31542 EXCITATION FUNCTIONS AND RECOIL RANGES OF RESIDUAL NUCLEI PRODUCED THROUGH Kr-INDUCED TRANSFER REACTIONS IN ^{209}Bi TARGETS. Bimbot, R.; Rivet, M.F. (Institut de Physique Nucléaire, Chimie Nucléaire, Orsay, France). Phys. Rev. C 8: No. 1, 375-379 (July 1973).

The excitation functions and projected recoil ranges for ^{211}At, ^{210}Rn, and ^{211}Rn produced through ^{84}Kr + ^{209}Bi reactions have been measured from 430 to 500 MeV. Substantial values have been found for the cross sections at high energies. The general features of the reactions (the shapes of the excitation functions and the variation of recoil range versus incident energy) are very similar to results found with lighter projectiles and are unambiguously characteristic of non-compound-nucleus processes. Complementary measurements performed on a natural Tl target show that the cross sections for four-charge- and five-charge-transfer reactions are of the order of 1 mb. Therefore, in the reactions ^{84}Kr + ^{209}Bi → ^{211}At, $^{210-211}$Rn, the contribution of the four- and five-charge transfers followed by fast α decay is not significant, and the main mechanisms involved are the transfers of two and three charges. (auth)

31543 CORROBORATION OF THE QUADRUPOLE ASSIGNMENT FOR THE 11-MeV GIANT RESONANCE IN ^{208}Pb. Lewis, M.B.; Bertrand, F.E.; Horen, D.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 8: No. 1, 398-400 (July 1973).

Inelastic scattering of protons with incident energy of 66 MeV has been used to study details of the giant-resonance region for several targets. Examination with high resolution of the recently observed resonance in ^{208}Pb at E = 11 MeV reveals fine structure. The data were compared with theoretical predictions for L = 2 and L = 0 angular distributions. Only the quadrupole interpretation was found to be consistent with the data. (auth)

31544 STUDIES OF ^{205}Bi AND ^{207}Bi PROTON-TRANSFER REACTIONS. Erb, K.A.; Gray, W.S. (Cyclotron Laboratory, Physics Department, The University of Michigan, Ann Arbor, Michigan 48105). Phys. Rev. C 8: No. 1, 347-358 (July 1973).

The (^{3}He,d) and (α,t) reactions on ^{204}Pb and ^{206}Pb targets were investigated at bombarding energies of 44 and 45 MeV, respectively, in order to measure the fragmentation of the proton levels in ^{205}Bi and ^{207}Bi. Orbital angular momentum transfers and spectroscopic factors were determined for those bound states containing more than 5–10% of the active single-proton strengths. The fragmentation of the low-lying $1h_{9/2}$ and $2f_{7/2}$ proton orbitals was found to be consistent with qualitative particle-core expectations in both ^{205}Bi and ^{207}Bi, while the $1f_{5/2}$, $2p_{3/2}$, and $2p_{1/2}$ strengths were distributed among a large number of levels. A level-by-level comparison between cross sections for the (α,t) and (^{3}He,d) reactions identified two high-l transitions to levels near 2.6 MeV in both isotopes. These observations suggest the presence of interactions between members of the $(3^-,h_{9/2})$ multiplet and at least one single-particle level from the next major shell as predicted by calculations in the case of ^{209}Bi. (auth)

31545 BREAKUP OF DEUTERONS IN THE FIELDS OF HEAVY NUCLEI. Jarczyk, L.; Lang, J.; Müller, R.; Balzer, D.; Viatte, P.; Marmier, P. (Laboratorium für Kernphysik, Eidg. Technische Hochschule, 8049 Zürich, Switzerland). Phys. Rev. C, 8: No. 1, 68-74 (July 1973).

The breakup of deuterons in the field of gold and lead nuclei was investigated experimentally. Angular correlations were measured at a deuteron energy of 12 MeV and, in the case of gold, also at 10.5 MeV. Furthermore, the energy dependence of the breakup cross section was studied with a gold target in the range lying between 7 and 12 MeV. Comparison of the experimental results with theoretical predictions based on a model which takes only Coulomb forces into account shows large discrepancies, the reason for which is presumed to be due to neglecting the nuclear interaction of the neutron in the final state. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 31035, 31318, 31478, 31486, 31498, 31509, and 31903.

31546 (CONF-730301-P1, pp 277-290) EXPERIMENTS WITH NEUTRON CAPTURE γ RAYS. Arad, B.; Ben-David, G. (Soreq Nuclear Research Center, Yavne, Israel). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Capture neutron γ rays have found applications in a variety of photonuclear reaction studies requiring γ rays in the energy region up to 11 MeV. The importance of these γ ray sources lies in that they provide very high intensities, which exceed by two orders of magnitude the intensities per unit energy interval obtainable from other sources. The experiments performed with these sources include photofission studies near threshold and resonance fluorescence of nuclear levels. (auth)

31547 (CONF-730301-P1, pp 319-320) ELASTIC AND RAMAN SCATTERING OF PHOTONS FROM ^{238}U. Bar-Noy, T.; Moreh, R. (Nuclear Research Centre-Negev, Beersheba, Israel). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The elastic and Raman scattering differential cross sections of ^{238}U for seven discrete photon energies between 7.9 and 11.4 MeV were measured. It is shown that, by making small changes in the parameters of the giant dipole resonance of ^{238}U, the measured cross sections are in reasonable agreement with predictions of the simple rotator model. (LTW)

31548 (CONF-730301-P1, pp 643-644) CROSS SECTION OF THE ^{238}U(γ,n)^{237}U REACTION NEAR THRESHOLD. Mafra, O. Y. (Instituto de Energia Atomica, Sao Paulo, Brazil); Cesar, M. F.; Kuniyoshi, S.; Goldemberg, J. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The ^{238}U(γ,n)^{237}U cross section was measured by the activation of natural uranium with monochromatic γ rays from the (n,γ) process at 6 to 9 MeV. (LTW)

31549 (CONF-730301-P1, pp 645-646) SUBBARRIER PHOTOFISSION OF ^{238}U. Alm, A.; Kivikas, T.; Lindgren, L. J. (Univ. of Lund, Sweden). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A series of measurements of symmetric and asymmetric photofission yields of ^{238}U in the energy region from 4.5 to 6.5 MeV was performed. As the γ source a high-intensity microtron giving an electron beam of about 50 μA with an energy spread of only 1% was used. Samples of natural U were irradiated directly in the vacuum tank. Chemical separations were carried out to get β samples of isotopes characteristic of symmetric fission (^{115,117}Cd and ^{111}Ag) and asymmetric fission (^{139}Ba). The β activities of these isotopes were measured for several half-lives with a low-background anticoincidence counter. (auth)

31550 (CONF-730301-P1, pp 647-648) INTERMEDIATE STRUCTURE IN THE PHOTONEUTRON, PHOTOFISSION, AND PHOTOABSORPTION CROSS SECTIONS OF ^{238}U AT THE FISSION THRESHOLD. Knowles, J. W. (Chalk River Nuclear Labs., Ont.); Mafra, O. Y. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The total photoneutron cross sections of ^{238}U (including both (γ,n) and (γ,fn) neutrons) was measured between 7 and 8 MeV. The cross section was calibrated against the photofission cross section measured previously. The photoabsorption cross section constructed from σ_n,σ_f, and σ_γ is shown. (LTW)

31551 (CONF-730301-P1, pp 649-650) LOW-ENERGY BREMSSTRAHLUNG PHOTOFISSION EXPERIMENTS. Gozani, T.; Bramblett, R. L.; Ginaven, R. O.; Rundquist, D. E. (Gulf Radiation Tech., San Diego, CA). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Prompt neutron yields and delayed neutron fractions are shown for bremsstrahlung-induced fission of ^{232}Th and ^{238}U at 5.3 to 8.1 MeV. (LTW)

31552 (CONF-730301-P1, pp 651-652) PROMPT AND DELAYED NEUTRONS FROM LOW-ENERGY PHOTOREACTIONS. Part II. Simultaneous Measurement of Prompt ν Bar, Γ_n/Γ_f, and Delayed Neutrons per Fission for ^{232}Th, ^{235}U, ^{238}U, and ^{239}Pu for 8, 10, and 12-MeV Bremsstrahlung. Caldwell, J. T.; Worth, G. M.; Dowdy, E. J. (Los Alamos Scientific Lab., NM). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The parameters prompt $\bar{\nu}$, Γ_n/Γ_f, and delayed neutrons per photofission are tabulated for photoneutron and photofission reactions with ^{238}U, ^{235}U, ^{232}Th, and ^{239}Pu at 8, 10, and 12 MeV. (LTW)

31553 (CONF-730301-P1, pp 653-654) ELECTRO AND PHOTOFISSION OF URANIUM. Nascimento, I. C.; Herdade, S. B.; Arruda Neto, J. D. T. (Univ., Sao Paulo, Brazil). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The electro- and photofission cross sections of uranium were measured in the energy range 8 to 52 MeV. (LTW)

31554 (CONF-730301-P2, pp 985-986) HIGH-ENERGY PHOTONUCLEAR REACTIONS. David, P.; Debrus, J.; Luebke, F.; Mommsen, H.; Schoenmackers, R.; Stein, G. (Univ., Bonn). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31555 (ISN-1972, pp 115-119) STUDY OF THE LEVELS OF ^{228}Ac. Herment, M.; Gizon, A. 1972. (In French).

The γ-ray spectra and electron spectra following the ^{228}Ra → ^{228}Ac decay were studied. The existence of nine transitions was established and the corresponding multipolarities were subse-

quently determined. Two components are deduced for the β spectrum. Two schemes are proposed for the possible levels of ^{228}Ac. (FR)

31556 (ISN-1972, pp 119-122) ^{234}Pa LEVELS ATTAINED IN THE DECAY OF ^{234}Th. Godart, J.; Gizon, A. 1972. (In French).

Research was carried out in the field of ^{234}Th → ^{234}Pa decay. Ironfree $\pi\sqrt{2}$ β spectrometers with Ge(Li) and Si(Li) detectors were used. The multipolarities of 19 transitions were determined in this way. A 70- to 73-keV transition with an M4 or E4 multipole order was not recorded in the electron spectrum. The results lead to the suggestion of an E3 + M1 cascade to explain the isomerism of ^{234}Pa. (auth)

31557 (RD/B/N-2710) CALCULATIONS OF FISSION PRODUCT ENERGY RELEASE. Tobias, A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1973. 30p. Dep. NTIS (U.S. Sales Only) $3.50.

By using the code FISP and its data library, calculations were performed of fission product energy release following various fission processes. The results of the calculations compared well with corresponding experimental values, particularly at decay times $t \geq 10^3$ seconds. The simple method employed to estimate the beta and gamma energy components of short-lived fission products was particularly successful in calculations of gamma energy release, and to a lesser degree for beta energy release following a single fission. However, the calculations of integral beta energy release were found to give good agreement with experiment for most decay times $t \geq 1$ second after fission. Although calculations of beta + gamma energy release were in reasonably good agreement with experiment for most decay times, the computed beta/gamma energy distribution differed considerably from experiment at decay times $t > 10^3$ s, at which times the important fission products had decay schemes which were well established. This discrepancy could be due to error in either the calculations or the measurements. (auth)

31558 (RLO-1388-222) FISSION ISOMER SYSTEMATICS. Vandenbosch, R. (Washington Univ., Seattle). 1973. 27p. (SM-174/203). Dep. NTIS $3.50.

The half-lives, decay properties, excitation energies, and production cross sections of spontaneously fissioning isomers are reviewed. Rotational, vibrational, and single-particle excitations of the shape-isomeric state are discussed. (auth)

31559 (RLO-1388-223) GAMMA BRANCH OF THE ^{238}U SHAPE ISOMER. Russo, P. A.; Pedersen, J.; Vandenbosch, R. (Washington Univ., Seattle). 1973. 21p. (SM-174/96). Dep. NTIS $3.25.

Systematics of the double-humped fission barrier predict a poorly developed inner barrier for the lower-Z actinide nuclei. Experimental evidence from delayed fission of even–even actinides suggests that the fission branch of the ^{238}U shape isomer decay represents only one tenth of the total width for shape isomer de-excitation. These observations indicate an inner barrier for ^{239}U sufficiently penetrable that the greater strength for shape isomer de-excitation is in the gamma branch. The 200-ns ^{238}U shape isomer was produced by the (d,pn) reaction with 18-MeV deuterons incident on natural uranium targets. The deuteron beam from the FN Tandem is pulsed. A Ge(Li) detector was used to observe the delayed gamma rays. Time and energy information for each event was stored. Most of the large number of delayed gamma lines were attributed to normal isomers in fission fragments by comparison of the energy spectra with other gamma spectra obtained in the same experimental configuration using different reactions which are not capable of populating the ^{238}U shape isomer. Of the remaining lines, most could be excluded by their half-lives, which are inconsistent with the 200-ns half-life of ^{238m}U. A line at 2.514 MeV was observed which is attributed to the decay of the shape isomer to the 0.045-MeV 2+ rotational state of ^{238}U. It has a half-life in agreement with that observed for the fission branch, and is produced with a yield consistent with predictions of a more penetrable inner barrier. A second weaker line was observed at 1.879 MeV, corresponding in energy to the transition from the shape isomer to the first excited 1-state at 0.680 MeV in ^{238}U. The decay of this line is also consistent with the measured half-life of ^{238m}U. (8 figures, 2 tables) (auth)

31560 ENERGY DEPENDENCE OF THE RATIO Γ_n/Γ_f FOR TRANSURANIUM ELEMENTS. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 37-38(Jul 1973). (In Russian).

It is shown that, contrary to a widespread opinion, at the excitation energies E*, higher than a few dozens MeV, the ratio of the (evaporative) width to the fission width, Γ_n/Γ_f, for transuranium elements depends essentially on the excitation energy. In reactions with heavy ions, as a rule, not the ratio Γ_n/Γ_f is measured, but some other, averaged over the evaporation channel, quantity, that shows no substantial energy dependence, both in the experiment and in the theory. The fact that such an almost constant quantity exists is of independent interest, however, it cannot be used to deduce that the ratio Γ_n/Γ_f is constant. (auth)

31561 ANGULAR DISTRIBUTIONS OF FRAGMENTS FROM FISSION OF NUCLEI ^{238}U, ^{232}Th, ^{209}Bi, ^{186}Re INDUCED BY PROTONS WITH T_p = 1 GeV. Zolotov, A. M.; Bochagov, B. A.; Andronenko, L. N.; Solyakin, G. E. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 1, 29-33(Jul 1973). (In Russian).

Using the solid-state detectors the angular distributions were measured for fission fragments emitted at exposing the nuclei ^{238}U, ^{232}Th, ^{209}Bi, and ^{186}Re to the proton beam with T_p = 1 GeV. Assuming the isotropic fragment emission in the fissile nucleus frame, the mean transfer velocities and the excitation energies for the nuclei are determined. Comparing the obtained results with the data from other works, one sees that up to the experimental errors in the uranium case the fissile nuclei have the same parallel component of the momentum transfer while the incident proton energy variates at least from 0.15 up to 2.9 GeV. A similar constancy of $p_{||}$ in the mentioned energy region was observed also in case of ^{209}Bi. (auth)

31562 ENERGY LOSS AND RANGE STRAGGLINGS OF α PARTICLES FROM ^{238}Pu IN SOME GASES. Demidovich, N. N.; Nakhutin, I. E.; Shatunov, V. G. Yadern. Fiz.; 18: No. 1, 133-141 (Jul 1973). (In Russian).

The energy loss and range straggling of the α particles from ^{238}Pu are studied in CH_4, CO_2, CF_4, CF_2Cl_2 and SF_6. The experimental data are compared with different theoretical calculations. The data for CO_2, CF_4 and SF_6 agree satisfactorily with calculations in the Payne–Titeica model. For methane there is a considerable difference between the theoretical and experimental absolute values. For CF_2Cl_2 the disagreement is not so large. (auth)

31563 SEARCH FOR A SPONTANEOUSLY FISSIBLE ISOMER NUCLEUS ^{236m}U IN REACTION ^{235}U(n,γ). Zen Chang Bom; Laitai, A.; Omel'yanenko, A. A.; Panteleev, Ts. Ts.; Polikanov, S. M.; Ryabov, Yu. V.; Tang San Khak. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 34-36(Jul 1973). (In Russian).

Results are presented on the experiment of search for a spontaneously fissible isomer nucleus ^{236m}U in the reaction ^{235}U(n,γ) at the neutron energy of ~60 keV. The measured quantity is $\sigma_a/\sigma_f \leq 1.5 \cdot 10^{-4}$. (auth)

31564 GAMMA RAYS EMITTED BY URANIUM AND THORIUM IN THE ENERGY RANGE 10 TO 120 keV. Taylor, H. W. (Univ. of Toronto). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 593-597(Oct 1973).

Gamma rays with energies below 120 keV emitted by uranyl acetate and thorium nitrate were studied with a Si(Li) detector. Improvements in the precisions of known γ ray energies were made and several new γ rays were observed for each radioactive chain. (auth)

Nuclear Theory

Refer also to abstracts 30406, 30410, 31072, 31073, 31154, 31225, 31242, and 31759.

31565 (CONF-730301-P1)) PHOTONUCLEAR REACTIONS AND APPLICATIONS. International Conference, Pacific Grove, California, March 26-30, 1973. Proceedings, Volume I. Berman, B. L. (ed.) (California Univ., Livermore. Lawrence Livermore Lab.). 1973. 714p. Dep. NTIS $27.20 (Vols. 1 and 2).

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

Separate abstracts were prepared for 138 papers in this volume. (LTW)

For abstracts of individual papers see: 29920, 29959–29962, 30703, 30704, 30732, 30733, 30752, 30753, 31048–31050, 31301–31312, 31328–31351, 31391–31397, 31415–31424, 31442–31450, 31466–31474, 31506–31508, 31525–31531, 31546–31553, 31566–31599, and 31855.

31566 (CONF-730301-P1, pp 43-55) COLLECTIVE MODEL OF THE PHOTONUCLEAR EFFECT. Danos, M. (National Bureau of Standards, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

An overview is presented on the present state of development of the collective model as far as it is related to photonuclear physics. The emphasis is placed on the conceptual aspects;

details of the formalism are easily accessible in the published literature. The presentation begins with the one-fluid model which is the quantized version of the liquid drop model. It continues with the two-fluid model which is the present version of the Goldhaber–Teller model, and then gives a brief description of the three-fluid model in which the excess neutrons are treated as a separate entity, viz., the third fluid. It concludes with a discussion of the meaning of the model. As it has become clear that nuclei exhibit strong long-range many-body correlations, it may be that in fact a liquid drop is a very good description of some aspects of nuclear structure. (auth)

31567 (CONF-730301-P1, pp 57-67) MICROSCOPIC MODELS. Brown, G. E. (State Univ. of New York, Stony Brook). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The position in energy of the giant, dipole resonance is discussed. Modern particle–hole interactions are expected to reproduce this. The relation between the particle–hole and particle–particle interaction is also discussed. It is pointed out that one should go back to the primary nucleon–nucleon interaction in evaluating the enhancement κ of the dipole sum rule. Large values of κ result. (auth)

31568 (CONF-730301-P1, pp 71-94) ELECTROMAGNETIC SUM RULES. O'Connell, J. S. (National Bureau of Standards, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A survey of total and partial nuclear cross section sum rules for photoabsorption and electron scattering is presented. The sums are derived from closure or the dispersion relation and are compared with available data and discussed in the context of the single-particle shell model. A few of the rules are model-independent or relate observables, but most are influenced either by the form of the effective two-nucleon interaction or by nucleon–nucleon correlations in the nuclear ground state. The relation of electron scattering sums in the low momentum transfer region to photo sums is emphasized. A new sum rule for elastic photon scattering is given. (39 references) (auth)

31569 (CONF-730301-P1, pp 95-106) DISCUSSION OF POSSIBLE MODIFICATIONS OF THE GELL-MANN–GOLDBERGER-THIRRING SUM RULE. Weise, W. (Univ., Erlangen, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A critical discussion of the Gell-Mann–Goldberger–Thirring sum rule shows that its predictions and underlying assumptions are in disagreement with both low- and high-energy photonuclear data: there are indications that the original assumptions about the high-energy properties of the photon–nucleus interaction have to be modified. A reformulation of the sum rule is proposed; the hadronic properties of high-energy photons are especially emphasized and studied in some detail. Sum-rule constraints on the high-energy behavior are discussed. (auth)

31570 (CONF-730301-P1, pp 107-108) ISOTENSOR DIPOLE PHOTO CROSS SECTIONS AND THEIR EFFECT ON MEASURABLE QUANTITIES. Leonardi, R.; Lipparini, E. (Univ., Bologna). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The isotensor radius r_t is connected with some measurable quantities, and this relation is used to extract the value of r_t. The nuclides ^{208}Pb, ^{150}Nd, and ^{90}Zr are analyzed numerically for various values of γ, where $\gamma = -(2T-1)\, r_t^2/r_v^2$. (LTW)

31571 (CONF-730301-P1, pp 109-110) HADRON POLARIZABILITIES AND NONRELATIVISTIC ISOSPIN SUM RULES. Cannata, F. (Univ., Bologna). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Hadron electric dipole polarizabilities are discussed in the framework of the nonrelativistic quark model, using sum rule techniques. (LTW)

31572 (CONF-730301-P1, pp 113-114) CENTER OF MASS CORRECTIONS. de Forest, T. Jr. (Inst. for Nuclear Physics Research, Amsterdam). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The center-of-mass problem in nuclear theory, i.e., the violation of translational invariance, is treated by improving the total nuclear wave function as opposed to the Lipkin approach in which only the internal structure is considered. This method gives the same results as the Lipkin method. (LTW)

31573 (CONF-730301-P1, pp 117-118) ELECTRON–NUCLEUS INTERACTION AND LOW-ENERGY APPROXIMANT. Bottino, A.; Ciocchetti, G. (Univ., Turin). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Approximation formulas are given for low-energy electron–nucleus interactions. This formula includes elastic and inelastic form factors for scattering and Coulomb, axial-vector, and weak-magnetism form factors for beta decay. (LTW)

31574 (CONF-730301-P1, pp 119-122) MICROSCOPIC ANALYSIS OF GIANT DIPOLE STATE IN DEFORMED NUCLEI. Takahashi, H. (Brookhaven National Lab., Upton, NY). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The excitation energy and strength of the giant dipole state for a deformed nucleus were studied using a one particle–one hole model degenerate three-dimensional axis harmonic oscillator wave functions. Calculated excitation energies and photon absorption cross sections of giant dipole states of ^{165}Ho are tabulated. (LTW)

31575 (CONF-730301-P1, pp 123-124) CORRELATION BETWEEN NEUTRON AND PHOTON WIDTHS. Boridy, E.; Mahaux, C. (Univ., Liege). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Predicted and experimentally observed correlations between partial widths in neutron and photon channels, and between these quantities and the spectroscopic factor of the final level, are interpreted in a shell-model approach to nuclear reactions. (LTW)

31576 (CONF-730301-P1, pp 125-126) STATISTICAL TESTS FOR INTERMEDIATE STRUCTURE. Baudinet-Robinet, Y.; Mahaux, C. (Univ., Liege). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A critical review of the principal statistical methods for detecting deviations from the statistical model is summarized, and some new tests are mentioned. (LTW)

31577 (CONF-730301-P1, pp 129-130) APPLICATIONS OF THE JASTROW MODEL. Weise, W.; Huber, M. G. (Univ., Erlangen-Nuernberg, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The applications of the Jastrow model, in which the independent-particle-model wave function is modified by introducing the effects of the short-range part of the NN interaction explicitly by means of a correlation function, are briefly discussed. Calculated angular distributions from the $^{12}C(\gamma,p)^{11}B_{g.s.}$ reaction are compared with experiment. (LTW)

31578 (CONF-730301-P1, pp 185-186) ELECTRON SCATTERING AND THE GENERALIZED COLLECTIVE MODEL. Borie, E.; Drechsel, D.; Lezuo, K. (Univ., Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The expression for the inelastic electron scattering form factor derived from the generalized collective model is shown. Excitation energies and form factors are given for ^{24}Mg and ^{64}Zm. (LTW)

31579 (CONF-730301-P1, pp 193-194) ELASTIC ELECTRON SCATTERING AND NUCLEAR MAGNETIZATION DISTRIBUTIONS. Wright, L. E.; Prewitt, J. F. (Ohio Univ., Athens). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The magnetization distribution in medium and heavy nuclei was studied by calculating electron elastic scattering from a nuclear charge distribution by conventional phase-shift analysis. Sufficient precision was used to ensure convergence even at 180°. The scattering was calculated using DWBA in which the Coulomb distortion is included exactly, and the scattering from the magnetic moments is approximated by one-photon exchange. (LTW)

31580 (CONF-730301-P1, pp 201-202) EIKONAL APPROXIMATION FOR MAGNETIC ELECTRON SCATTERING. Murphy, J. D.; Ueberall, H. (Catholic Univ. of America, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The eikonal approach for transverse electron scattering of arbitrary multipolarity is formulated. Elastic form factors for magnetic scattering from ^{209}Bi are shown. (LTW)

31581 (CONF-730301-P1, pp 207-208) SHELL MODEL DESCRIPTION OF PHOTOPROTON SPECTRA IN HEAVY NUCLEI. Shoda, K. (Tohoku Univ., Sendai). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Calculated photoproton spectra for several nuclei are shown. The energies of the proton groups obtained by shell-model calculations are compared with experimental values. (LTW)

31582 (CONF-730301-P1, pp 259-261) LIMITATIONS AND CORRECT INTERPRETATION OF PRESENT BREMSSTRAHLUNG DATA. Thies, H. H. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Experimental errors and generations of cross sections from (γ,n) bremsstrahlung experiments using "energy sweeping" are examined statistically. (LTW)

31583 (CONF-730301-P1, pp 407-416) ISOSPIN SPLITTING OF THE GIANT DIPOLE RESONANCE. Paul, P. (State Univ. of New York, Stony Brook). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Recent successes and failures to determine the isospin of photonuclear resonances are presented. The accumulated experimental evidence for the isospin splitting of the GDR is surveyed over the entire nuclear range. The systematics of some properties are discussed with emphasis on the energy displacement of the $T_>$ and $T_<$ components. The assumption of a symmetry energy $U = V/(AT)$ with $V \approx 55 \pm 15$ MeV is shown to hold from A = 11 to 181. (32 references) (auth)

31584 (CONF-730301-P1, pp 417-437) ISOSPIN MIXING IN GIANT RESONANCES. Hanna, S. S. (Stanford Univ., CA). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The evidence on the isospin mixing in the giant M1 and E1 resonances of nuclei is examined. The information on the giant M1 resonances is more extensive and shows that (1) isotensor mixing is comparable to isovector mixing and (2) the Coulomb force may not be sufficient to account for the amount of mixing observed. For the E1 resonances the experimental situation needs clarification. From a comparison of (γ,p_0) and (γ,n_0) cross sections it appears that the nature of the isospin mixing may be similar to that observed in the M1 resonances. However, in particular the (γ,α) cross sections in self-conjugate and non-self-conjugate nuclei are not yet understood. Evidence on the amount of E2, T = 0 mixing in the giant E1 resonances is also presented. (65 references) (auth)

31585 (CONF-730301-P1, pp 439-448) DECAY OF THE GIANT RESONANCE AND INTERMEDIATE STRUCTURE. Shakin, C. M. (Case Western Reserve Univ., Cleveland). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A projection operator formalism for the description of intermediate structure in the photodisintegration of light nuclei is presented. The general case requires a discussion of two types of doorways, those for the entrance (photon) channel and those for the decay (nucleon) channels. The theoretical results are simplest if the same doorways, the "giant-dipole states", may be used for both channels. The various assumptions for doorway dominance in the couplings of subspaces of the full Hilbert space are presented. These are discussed with particular attention being given to the photodisintegration of ^{16}O. (auth)

31586 (CONF-730301-P1, pp 449-462) PHOTON SCATTERING BY NUCLEI: THEORY AND EXPERIMENT. Arenhoevel, H. (Univ., Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The theoretical description of photon scattering by nuclei is reviewed and the information on nuclear structure which can be obtained in photon scattering experiments is discussed. Particular emphasis is laid on the region of the giant dipole resonance. The dynamical properties of nuclei which determine the scattering process are contained in the nuclear polarizabilities. Experimental conditions for the determination of the polarizabilities are reviewed. Theoretical predictions of the polarizabilities in the framework of the dynamic collective model are summarized and compared with experimental findings. Furthermore, a short discussion of Delbrück scattering is given. (52 references) (auth)

31587 (CONF-730301-P1, pp 465-466) SOME REMARKS ON n-p RADIATIVE CAPTURE. Colocci, M.; Mosconi, B.; Ricci, P. (Univ., Firenze, Italy). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Some preliminary theoretical results on n–p and n–d radiative capture using both soft- and hard-core potentials are presented. (LTW)

31588 (CONF-730301-P1, pp 483-484) INTEGRATED PHOTODISINTEGRATION CROSS SECTION FOR NUCLEI. Srivastava, B. K.; Yadav, H. L. (Indian Inst. of Tech., Kharagpur). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The integrated nuclear photodisintegration cross section in the electric-dipole approximation is discussed. Numerical results are tabulated for ^{6}Li, ^{8}Be, ^{12}C, ^{16}O, and ^{40}Ca and compared with results of Levinger and Bethe. (LTW)

31589 (CONF-730301-P1, pp 489-491) STRUCTURE OF THE GIANT RESONANCE IN 1p SHELL NUCLEI. Aswad, A. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Kissener, H. R.; Eramzhian, R. A.; Jaeger, H. U. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

An improvement in the particle–hole description of the structure of the giant resonance for nonmagic nuclei in the 1p shell is reported in which the full basis of 1 $\hbar\omega$ excitations is used. Integrated dipole strengths and cross sections are shown for A = 7, 8, 13, and 14 nuclei. (LTW)

31590 (CONF-730301-P1, pp 499-500) COULOMB POLARIZATION AND DIRECT E1 RADIATIVE CAPTURE OF DEUTERON IN SELF-CONJUGATE NUCLEI. Jang, S. (Institut des Sciences Nucleires, Grenoble, France). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

An incident deuteron may be electrically polarized by the Coulomb field of the target nucleus. The polarized-deuteron wave function was calculated. (LTW)

31591 (CONF-730301-P1, pp 501-502) GENERAL PROPERTIES OF NUCLEAR CURRENTS. Bosco, B. (Univ., Firenze, Italy). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Some general properties of nuclear currents are pointed out. Since these properties follow directly from the fact that these currents are restricted to a finite region of space, they must be satisfied by any kind of currents which must be zero outside the nucleus. Exchange currents are cited as an example. (LTW)

31592 (CONF-730301-P1, pp 503-504) SEPARABLE GREEN FUNCTION APPROXIMATION IN COUPLED CHANNEL REACTION THEORY. Birkholz, J. (Technische Hochschule, Darmstadt, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A simplified approach for constructing simple explicit solutions to coupled-channel equations in an approximate fashion is described. The calculated ^{12}C photoabsorption cross section using this approach is shown and compared with the exact solution. (LTW)

31593 (CONF-730301-P1, pp 567-568) KERMAN–QUANG ANALYSIS OF GIANT-RESONANCE DATA. Berman, B. L. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The Kerman–Quang method relates the parameters of the giant dipole resonance of a nucleus to its ground-state vibrational

character. Specifically, the shape of the giant resonance for a spherical vibrational nucleus is depicted as a superposition of Lorentz curves, each having an intrinsic width which corresponds to the case in which the nucleus is infinitely stiff. The position of these Lorentzians is modulated by a probability function (taken to be Gaussian) centered at the energy corresponding to the equilibrium shape, thus resulting in a broadening of the giant resonance. The total photoneutron cross section data for ^{75}As are fitted by the Kerman–Quang prescription. (LTW)

31594 (CONF-730301-P1, pp 569-570) MASS VARIATION OF THE NUCLEAR SYMMETRY ENERGY. Berman, B. L. (Univ. of California, Livermore). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The nuclear symmetry energy (the coefficient of $(N-Z)^2/A$ in semiempirical mass formulas) is calculated and shown as a function of A over the range A = 70 to 210. (LTW)

31595 (CONF-730301-P1, pp 641-642) EXCITATIONS OF FISSILE NUCLEI BY RADIATIONLESS TRANSITIONS IN MUONIC ATOMS. Evseev, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR); Kozlowski, T.; Mamedov, T.; Roganov, V. S.; Sujkowski, Z.; Wojtkowska, J.; Zglinski, A. 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The radiationless nuclear excitation effect was verified in direct observations of prompt neutrons emitted during fission of several nuclides. The prompt-to-delayed neutron ratios of ^{232}Th, ^{233}U, ^{235}U, ^{236}U, and ^{239}Pu are shown. The ratios of neutron width to fission width are tabulated for ^{239}Pu, ^{239}Np, ^{238}Np, and ^{237}Np. (LTW)

31596 (CONF-730301-P1, pp 657-658) SYSTEM FOR STUDY OF PHOTONUCLEAR REACTIONS NEAR THRESHOLD USING NEUTRON CAPTURE γ RAYS. Hill, J. C. (Texas A and M Univ., College Station). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A system for the study of photonuclear processes near threshold using neutron capture γ rays ranging in energy from 5 to 11 MeV was installed at the TAMU 1 megawatt Triga reactor. The experimental setup is shown. The capture γ rays were produced by a thermal neutron flux of 5×10^{12} n/cm^2 · sec incident on various targets sealed in rectangular welded Al boxes placed in a holder adjacent to the reactor core. The targets consisted typically of 0.5 to 3.0 kg of various materials such as Ti, Cu, Fe, Se, HgS and melamine (N). (auth)

31597 (CONF-730301-P1, pp 659-660) "SHELF" IN THE SUBTHRESHOLD PHOTOFISSION CROSS SECTION. Bowman, C. D. (National Bureau of Standards, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The shape of the photofission cross section far below the (γ,n) threshold is analyzed, and the phenomena encountered there are discussed. (LTW)

31598 (CONF-730301-P1, pp 663-673) ELECTROEXCITATION OF M1 TRANSITIONS. Fagg, L. (Naval Research Lab., Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The field of electroexcitation of nuclear M1 transitions is reviewed. The subject is introduced with an elementary description of the relationship between backward-angle electron scattering and M1 excitation. The discussion of experimental results emphasizes the strength of the spin-flip transition, the concentration of M1 strength in self-conjugate nuclei, the degree of fragmentation of this strength in other nuclei, and the response of odd-A rotational nuclei and heavy nuclei to 180° electron scattering. (auth)

31599 (CONF-730301-P1, pp 709-710) QUASIELASTIC (e,e′) SCATTERING AND ELECTROEXCITATION OF GIANT RESONANCES. Klawansky, S. (Massachusetts Inst. of Tech., Cambridge). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Several spectra at constant momentum transfer are shown for electron quasielastic scattering by ^{209}Bi at $\Theta = 76.5°$ are shown. In order to obtain the magnitude of the single-particle knockout contribution in the tail region of the spectra, the quasielastic cross section for knocking nucleons out of their shell model bound states was calculated. The quasielastic cross section was then substracted from the low-energy part of the spectra to study the excitation form factor. (LTW)

31600 (CONF-730301-P2, pp 847-855) WHAT CAN BE LEARNED FROM A MODEL INDEPENDENT ANALYSIS OF ELASTIC ELECTRON SCATTERING DATA? Luehrs, G. (Univ., Mainz). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The reasons for and consequences of a model-free analysis of high energy elastic electron scattering experiments are briefly reviewed. The senseful use of model independent integral quantities of the nuclear charge distribution is discussed for typical experimental results, especially for small differences between neighboring nuclei. The partial moment-function T(Q) and the moment-function M(k) are used for this purpose. An outlook to further developments leading to a qualitative picture for $\rho(r)$, including its error bars, is given. (auth)

31601 (CONF-730301-P2, pp 871-880) ELECTRON SCATTERING IN LIGHT NUCLEI. Theissen, H. (Technische Hochschule, Darmstadt, Ger.). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Some recent electron scattering results for light nuclei are reviewed. The model independence of low-q measurements is discussed. (auth)

31602 (CONF-730301-P2, pp 909-923) CLASSICAL IMAGES FOR THE RADIATIVE CAPTURE OF FAST NUCLEONS. Halpern, I. (Univ. of Washington, Seattle). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

A picture for nucleon capture by nuclei is developed in which the radiation amplitudes bear their classical relations to the accelerations and velocities of the charges which constitute the radiating system. It is shown that the implications of this picture are in good agreement with many average or general features of the experimental data. More particularly, the now familiar expression for the effective charge factor associated with the dipole polarizability of the nucleus is derived, and some of its limitations are briefly discussed. Also the magnitudes, energy dependences and correlations of the coefficients a_1 and a_2 which appear in the general expression, $A_0[1 + \Sigma_{n>0} a_n P_n(\cos\theta)]$, for the angular distribution of emitted radiation are examined. It is found, for example, that the commonly observed forward-folding of proton capture angular distributions (represented by positive values for a_1) can be understood in terms of the speed of the incident projectile. A number of other common features of the capture observations are also found to be in qualitative accord with expectations based on rather elementary classical pictures. (auth)

31603 (CONF-730301-P2, pp 997-998) SYSTEMATICS OF INTERMEDIATE- AND HIGH-ENERGY PHOTON INDUCED SPALLATION YIELDS. Jonsson, G. G.; Lindgren, K. (Lund Inst. of Tech., Sweden). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31604 (CONF-730301-P2, pp 1273-1277) DOES NUCLEAR PHYSICS REALLY MATTER? Weinberg, A. M. (Oak Ridge National Lab., TN). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31605 (CONF-730301-P2, pp 1281-1291) NUCLEAR CHARGE DISTRIBUTIONS. Ravenhall, D. G. (Univ. of Illinois, Urbana). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

Two topics concerning charge distributions are discussed. The effect on charge distributions of assumptions made about their very high Fourier coefficients is considered. Some recent "model-independent" electron-scattering analyses are criticized from this viewpoint, and a better approach is suggested. Some new results on dispersion effects on elastic scattering are reported. Proper inclusion of the multipolarity in E2 virtual excitation is shown to reduce considerably the contribution to inferred isotopic charge-density differences. (auth)

31606 (CONF-730301-P2, pp 1351-1355) APPLICATION OF PHOTONUCLEAR PHYSICS. Bowman, C. D. (National Bureau of Standards, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

31607 (INR-1460) NUMERICAL PROGRAM FOR CALCULATION OF THE SUPERCONDUCTIVITY FUNCTIONS AND THE NUCLEAR LEVEL DENSITY. Grochulski, W.; Marcinkowski, A. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 41p. Dep. NTIS (U. S. Sales Only) $4.25.

A detailed description of the program solving the superconductivity equations and calculating the nuclear level density is given. (auth)

31608 (ORO-4317-24) EXCHANGE POTENTIALS IN RELATIVISTIC HARTREE–FOCK THEORY OF CLOSED SHELL NUCLEI. Miller, L. D. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jul 1973. 64p. Dep. NTIS $5.25.

The relativistic Hartree formalism for nuclei is extended to include the exchange potentials which result from various kinds of one-boson-exchange interactions. A numerical simplification, unique to the relativistic case, is presented. This simplification uncouples the relativistic Hartree–Fock equations, and enables local (though state-dependent) single-particle potentials to be defined for the exchange interactions. Calculations are presented for a vector-scalar nucleon-nucleon force model. Comparison of these calculations with Hartree calculations (using the same model) indicates that the exchange terms contribute a net attraction of about 1.5 MeV per particle in light nuclei while radii are reduced by about .03 fermi. A study is also made of the exchange potentials resulting from the pseudoscalar part (one-pion-exchange) of the nucleon–nucleon interaction. These terms appear to be important, although self-consistent calculations are not possible in the present framework due to numerical instabilities induced by the pseudoscalar term. The instabilities are shown to be related to an incorrect enhancement of the effects of virtual $N-\bar{N}$ pair creation which is present in the coordinate space relativistic one-pion-exchange potential. (12 figures, 4 tables) (auth)

31609 (ORO-4317-25) RELIABILITY OF THE SEPARATION METHOD FOR THE EFFECTIVE INTERACTION IN INELASTIC SCATTERING. Technical Report No. 74-008. Redish, E. F.; Dixon, R. M. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jul 1973. 12p. Dep. NTIS $3.00.

The separation method of Moszkowski and Scott has recently been used to generate an effective interaction for inelastic scattering. This approximation for the two-nucleon $^1S_0$ state is investigated in a realistic model. It is found that the method only yields reliable off-shell matrix elements for low energies and momenta near the on-shell point. (auth)

31610 (ORO-4317-30) THEORETICAL STUDIES IN NUCLEAR REACTION AND NUCLEAR STRUCTURE. Progress Report, September 1, 1972–September 1, 1973. MacDonald, W. M.; Griffin, J. J. (Maryland Univ., College Park. Dept. of Physics and Astronomy). 1973. Contract AT(40-1)-4317. Dep. NTIS $4.25.

Research in the following areas is briefly summarized: nuclear structure and properties, nuclear reactions, nucleon–nucleon interaction, fission, few-nucleon problem, interactions of hadrons with nuclei, interactions of leptons with nuclei, and Q.E.D. of strong fields. Lists of publications and papers contributed to meetings are also included. (RWR)

31611 NUCLEAR SPECTROSCOPY WITH THE BHMM FORMALISM. Hefter, E. F. (Max-Planck-Institut fuer Kernphysik, Heidelberg). (1973). vp. (In German).

From Spring meeting of the Deutsche Physikalische Gesellschaft. Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

The formalism for (d,p) reactions proposed by Butler et al. [S. T. Butler, R. G. L. Hewitt, B. H. J. McKellar and R. M. May, Ann. Phys. 43 (1967) 282] is investigated in order to obtain reliable spectroscopic information. A more detailed study is made for the reaction $^{12}C(d,p_0)^{13}C$, for which experimental results are available in the incident deuteron energy range from 1.8 to 51 MeV. By taking the distinctive features of the model into account, the spectroscopic amplitudes can be determined more reliably within the BHMM formalism than by conventional DWBA. (2 figures) (tr-auth)

31612 CORIOLIS EFFECTS IN EVEN DEFORMED NUCLEI. Simon, R. S. (Univ., Munich). (1973). vp. (In German).

From Spring meeting of the Deutsche Physikalische Gesellschaft. Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

Strongly reduced energy differences have been observed between high-spin states in the rotational states of even nuclei. This behavior implies a change in the characteristics of the yrast states in this spin region. This can be interpreted in terms of the ground-state bands being cut by those two-quasi-particle bands which have the lowest energy due to the large Coriolis interaction for these high spins. The results of calculations within the framework of this model are discussed. (auth)

31613 INFLUENCE OF DIRECT REACTIONS ON HAUSER–FESHBACH FORMULAS AND ERICSON FLUCTUATIONS. Engelbrecht, C. A. (Univ., Heidelberg); Weidenmueller, H. A. (1973). vp. (In German).

From Spring meeting of the Deutsche Physikalische Gesellschaft. Part A, nuclear physics; Heidelberg, Germany (19 Feb 1973).

The assumption is made that the complex energies and the partial amplitudes in the resonance expansion of the S matrix are non-correlated stochastic variables. By neglecting correlations between different levels the mean values of the n-th powers of S can be expressed by the mean value of S and by the m-th moments of the partial amplitudes with $m \leq 2n$. Assuming, furthermore, that the partial amplitudes are Gauss distributed, one can derive modified Hauser–Feshbach expressions which take into account the effects of direct reactions. These expressions are discussed. The application of the same formalism to Ericson fluctuations shows that the direct and compound cross sections which occur in the Ericson theory can be identified with the analogous quantities in the Hauser–Feshbach theory. The presence of direct reactions does not lead to vanishing cross correlations between different channels. The magnitude and the form of these correlations are discussed. (GE)

31614 ROTATIONAL-OPTICAL MODEL AND THE SIMILAR CHANNELS EFFECT. Sevgen, A. (Univ., Freiburg i. B.). Z. Phys.; 262: No. 3, 221-230(1973).

It is shown that the structure of the deformed real and imaginary parts of the phenomenological optical model potential for rotational nuclei can be understood from a microscopic point of view. We point out that some channels that differ only in the rotational state of the target are rather similar in structure. The consequences of this similarity as regards the imaginary part of the microscopic optical matrix potential for low energies (few MeV or less), the average direct and compound cross-sections, the validity of the Hauser–Feshbach formalism and the experiment are investigated. (1 figure) (auth)

31615 TWO-NUCLEON TRANSFER REACTIONS BETWEEN HEAVY IONS. Kammuri, T. (Kernforschungsanlage, Juelich, Ger.); Kubo, K. I.; Une, T. Z. Phys.; 262: No. 5, 439-450(1973).

A DWBA formulation of the two-nucleon transfer reactions between heavy ions is presented, neglecting the recoil effect. The perturbation is assumed to act between the core and each of the transferred pair. When we approximate the interaction so as to act between the core and the c. m. of the pair, we can extend the method commonly used in analyzing (t,p) and (p,t) reactions. Integrals appearing in the DWBA form factor are evaluated exactly. Calculations are compared with the experimental data in the case of the $^{26}Mg(^{18}O, ^{16}O)^{28}Mg$ reaction. (2 figures, 1 table) (auth)

31616 INTERMEDIATE STRUCTURE IN ISOSPIN-FORBIDDEN REACTIONS. Friedman, W.A. (Department of Physics, University of Wisconsin, Madison, Wisconsin, 53706). Phys. Rev. Lett. 30: No. 9, 394-397 (26 Feb 1973).

A model is proposed which leads to intermediate structure in isospin-forbidden reactions. It is shown that the effects predicted by the model occur in the recent data of Jolivette for $^{16}O(d,\alpha_1)^{14}N(2.31)$. (auth)

31617 GAMMA–GAMMA ANGULAR CORRELATIONS PERTURBED BY STOCHASTIC FLUCTUATING FIELDS. Winkler, H.; Gerdau, E. (Univ., Hamburg). Z. Phys.; 262: No. 5, 363-376 (1973).

On the basis of the stochastic model of M. Blume for time-dependent hyperfine interactions the perturbation factors of the angular correlation function are evaluated. The results of numerical calculations for some special configurations of stochastic fluctuating field gradients as well as magnetic fields are presented. In the medium range, where the fluctuation rates are comparable with the nuclear precession frequencies, interesting features are worked out for the spinrotation spectra. For the limiting case of very fast fluctuations it is proved that the well-known exponential decay of anisotropy as predicted by the theory of Abragam and Pound appears. (3 figures) (auth)

31618 CLASSICAL TIME CORRELATION FUNCTION THEORY OF PROTON TRANSFER REACTIONS. Rosenstein, R. A. (Technische Univ., Munich). Ber. Bunsenges. Phys. Chem.; 77: No. 7, 493-507(1973).

Using a correlation function description, the rate constant for protonic reactions is evaluated within the framework of established transition state and diffusion models. The dual importance of weak proton-reservoir coupling and asymptotic time scales for

the kinetic isotope effect, the inclusion of internal friction in the rate constant, and specifying the calculated Arrhenius parameters in thermodynamic language are emphasized. Finally, the coupling mechanisms and asymptotic time scales are linked to the interrelated question of the validity of the macroscopic transport law and correlation function description of the rate constant. (GE)

31619 TENSOR DEGREE OF FREEDOM OF NUCLEAR SHAPE. Chen, M. Y. (Columbia Univ., New York). Nucl. Phys.; A213: No. 1, 200-220(1973).

The nuclear deformation is described by the shape of the surfaces of constant nuclear density, which can be spin-dependent. The most general deformed surfaces should be described by matrix equations dependent upon the spin coordinate as well as the spatial coordinates. The characteristic dependence of the two-nucleon tensor interaction on the spin and the angular coordinates of each individual nucleon should give the nuclear surfaces a tensor degree of freedom. Based on these rather general observations, it is argued that the excitation of this degree of freedom must be a prominent feature common to all nuclei. A single-particle model with tensor deformation is solved numerically. Based on this specific model, it is speculated that permanent tensor deformation in the nuclear density might exist in heavy nuclei, especially those near magic nuclei. The strength of the tensor part of the M1 interaction between the nucleons and a lepton in the interior of the nucleus is greatly enhanced for the excitation of the tensor degree of freedom. The inelastic lepton scattering with a momentum dependence characteristic of the short range nature can provide an unambiguous test for the existence of tensor vibrational or tensor rotational states in nuclei. (auth)

31620 PAIRING AND SPIN DISTRIBUTION EFFECTS ON THE YRAST LINE. Moretto, L. G. (Univ. of California, Berkeley). Phys. Lett., 46B: No. 1, 20-22(3 Sep 1973).

The shape of the yrast line in the paired region is studied on the basis of the uniform model and of two extreme spin projection distributions. It is shown that the form of the yrast line depends strongly upon the assumed spin projection distributions. (auth)

31621 NUCLEAR REACTIONS. Gibson, W. M. Harmondsworth, Eng.; Penguin Books (1971). 286p.

Following a short introductory section, the subject is dealt with in chapters: particle accelerators, kinematics, reactions of light nuclei, wave-mechanical theory of scattering, resonant scattering and reactions, reaction mechanisms (including formation of compound nucleus, resonance reactions, optical model, direct reactions), neutrons, nuclear reactors, thermonuclear reactions (including thermonuclear reactions in stars), nuclear forces (including charge independence, the ground state of the deuteron, neutron–proton scattering), nuclear spin (including polarization experiments, polarized beams, nuclear polarization in solids). (UK)

31622 ONE-BOSON-EXCHANGE POTENTIALS AND NUCLEAR STRUCTURE. Calogero, F. (Istituto di Fisica dell'Università, 00185 Roma, Italy); Levi, D. Phys. Rev. C 8: No. 1, 83-92 (July 1973).

Some of the recently proposed one-boson-exchange nucleon-nucleon potentials are discussed in the many-nucleon context. (auth)

31623 SEPARABLE REPRESENTATIONS OF TWO-BODY INTERACTIONS. Ernst, D.J.; Shakin, C.M.; Thaler, R.M. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. C 8: No. 1, 46-52 (July 1973).

Consideration is given to the approximation in which an arbitrary potential is replaced by a separable potential. A method is presented which permits the construction of a rank-N separable potential which has the property that the resulting T matrix is exact on the energy shell and half off the energy shell at N-selected bound state and/or continuum energies. This construction yields a T matrix that is correct off the energy shell in the vicinity of the N on-shell points. (auth)

31624 JASTROW-TYPE BRUECKNER-HARTREE-FOCK CALCULATION FOR FINITE NUCLEI. Shao, J.; Lomon, E.L. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. C 8: No. 1, 53-67 (July 1973).

The moderate strength and smoothness of two-body forces for interparticle distances $r \geq 1$ fm implies that the Hartree-Fock (HF) wave functions are accurate for those separations. The nearly constant density of nuclei inside a surface region of 1 fm thickness implies that even in as light a nucleus as oxygen the nuclear-matter Bethe-Goldstone (BG) wave functions are accurate for most pairs at $r \leq 1.5$ fm. The few pairs with c.m. coordinate R in the surface region will be accurately represented on the average only. Accurate BG and oscillator-basis HF calculations using realistic Feshbach-Lomon (FL) interactions show that both wave functions agree well for 1 fm $< r < 1.5$ fm as expected. Consequently a configuration-space Jastrow wave function of sufficient accuracy can be constructed. Matrix elements of density and of energy are calculated using the HF functions for $r > r_s$ and the BG functions for $r < r_s$, with r_s chosen anywhere in the region 1–1.5 fm. Values of the off-shell interior boundary condition b of the FL interaction are used which give good nuclear-matter properties and favorable HF results for nuclei from ^{4}He to ^{48}Ca. The corrections due to the BG correlations result in accurate binding energies and moderately good single-particle energies for ^{16}O, ^{40}Ca, and ^{48}Ca. (auth)

31625 CONSEQUENCES OF ISOSPIN AND OTHER CONSERVED QUANTUM NUMBERS FOR COMPOUND-NUCLEUS REACTIONS. Robson, D. (Department of Physics, Florida State University, Tallahassee, Florida 32306); Richter, A.; Harney, H.L. Phys. Rev. C 8: No. 1, 153-160 (July 1973).

Consequences of the conserved isospin quantum number T are developed for compound-nucleus reactions with particular emphasis on statistical cross-section fluctuations. The formalism is based on the Hauser-Feshbach and Ericson theories. The appropriate autocorrelation function in case of levels of two different isospin values in the compound nucleus contains an interference term between two Lorentzian functions that are associated with the two isospins. The formalism is applied to the statistical reactions ^{54}Cr(p,p) and ^{54}Cr(p,α), where the coherence widths in the proton and α channels are markedly different. This is attributed to the decay properties of states with different isospin in the compound nucleus ^{55}Mn. The formalism developed for the isospin quantum number T can be extended to other quantum numbers. For the case of angular momentum and parity $J\pi$ interesting consequences with respect to heavy-ion reactions are discussed. (auth)

31626 SPECIFIC NEW APPROACH TO FINITE RANGE DISTORTED-WAVE BORN APPROXIMATION. Charlton, L.A. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 8: No. 1, 146-152 (July 1973).

A new method for calculating finite-range distorted-wave Born-approximation matrix elements is fully developed. This method is based on plane-wave expansions of the distorted waves which allows a separability feature not found in the usual approach. A spin orbit interaction is included for both the bound states and the distorted waves. (auth)

31627 OPERATOR AVERAGES IN A SHELL-MODEL BASIS. Ginocchio, J.N. (Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. C 8: No. 1, 135-145 (July 1973).

Using the theory of groups the many-particle average of the product of one-body operators is determined in terms of the one-body average of the products of these operators. With this all the energy moments of the noninteracting system are derived in terms of the one-particle moments. For the interacting systems the third and fourth moments are derived. (auth)

31628 SELF-CONSISTENT TREATMENT OF THE PAULI OPERATOR IN THE BRUECKNER-HARTREE-FOCK APPROACH. Tripathi, R.K. (Institut für Kernphysik, Kernforschungsanlage Jülich, Jülich, West Germany); Faessler, A.; MacKellar, A.D. Phys. Rev. C 8: No. 1, 129-134 (July 1973).

Brueckner-Hartree-Fock (BHF) equations are derived including the correction due to treating the Pauli operator in the HF basis instead of the single oscillator basis, both for standard BHF and for a variational calculation. Calculations were done with an approximate energy denominator. The correction effects for ^{16}O are significant: about a 10% decrease in total binding energy, 12–30% decreases in single-particle energies, and up to 20% decrease in the peak of the charge-density distribution. (auth)

31629 SUPERSTRANGE NUCLEI. Kerman, A.K.; Weiss, M.S. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. C 8: No. 1, 408-410 (July 1973).

A very crude model is used to estimate multiple Λ production in heavy-ion scattering at very high energies. We conclude that hyperfragments containing many Λ's could be formed with reasonable cross sections (superstrange nuclei). (auth)

31630 GENERAL FORMALISM FOR THE TRANSITION MATRIX OF NUCLEAR REACTION THEORY AND ITS APPLICATION TO THE STUDY OF POTENTIAL SCATTERING. Perez, R.B. (Neutron Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 8: No. 1, 8-22 (July 1973).

One develops a general integrodifferential equation for the transition matrix of nuclear reaction theory in terms of the physical parameters of the nuclear reaction. One derives, as a corollary of the main result, a system of equations which describes the motion of the poles and

residues of the collision matrix as a function of the parameters entering in the reaction formalism. Some applications to the study of the potential–scattering problem are also shown. (auth)

31631 TWO–LEVEL R–MATRIX THEORIES AND CALCULATIONS. Westin, G.D.; Adams, J.L. (Department of Physics, Ohio University, Athens, Ohio 45701). Phys. Rev. C 8: No. 1, 1-7 (July 1973).

The situation of two closely spaced resonance levels of the same spin and parity in a single channel is investigated. The conventional R–matrix theory is compared to a generalized R–matrix theory which allows for different boundary conditions for each level. The two $(3/2)^+$ resonances near 3 MeV in the $^{12}C(n, n)^{12}C$ reaction and the $(1/2)^+$ resonance dip at 2.4 MeV in the $^{16}O(n, n)^{16}O$ reaction are investigated. With no background term R_0, equivalent fits to the data can be found using a wide range of boundary conditions and corresponding reduced widths. This shows that there are ambiguities in the reduced widths of levels, depending on the values of other parameters used in fitting the levels. The conventional R–matrix theory fits the data well and allows for inclusion of distant levels through an R_0 term. The inclusion of an R_0 term for unequal boundary conditions introduces new parameters and becomes quite complicated. Thus, we conclude that the conventional R–matrix theory is not only adequate to fit closely spaced resonances of the same spin and parity, but it is preferred. (auth)

31632 COMPUTATIONAL APPROACH TO THE INVERSE PROBLEM IN THE JWKB APPROXIMATION. Kujawski, E. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. C 8: No. 1, 100-105 (July 1973).

A previously presented method based on the JWKB approximation for constructing a local optical potential from a complete set of complex phase shifts at a single energy is further developed. The Coulomb interaction is explicitly included. By using a pointwise rational–fraction method for numerical analytic continuation the optical potential is directly computed from the experimental phase shifts. The above procedure is applied to the elastic scattering of 104–MeV α particles by ^{12}C and ^{90}Zr, and it is found to be quite practicable and reliable. (auth)

31633 DETERMINATION OF FRACTIONAL–PARENTAGE COEFFICIENTS FROM INELASTIC SCATTERING OF PROTONS THROUGH ANALOG RESONANCES. Verhaar, B.J.; van Eeghem, W.P.T. (Department of Physics, Technische Hogeschool, Eindhoven, Netherlands). Phys. Rev. C 8: No. 1, 420-421 (July 1973).

Nuclear fractional–parentage coefficients, determined from inelastic proton scattering through isobaric analog resonances, are shown to be subject, in some circumstances, to a particular type of ambiguity. A simple linear transformation connects sets of such coefficients giving rise to indistinguishable resonance contributions to differential cross–section and analyzing power, if the relatively weak j dependence of penetration factors, resonance mixing phases, and real optical–model phase shifts is neglected. (auth)

31634 NUCLEAR MOMENT OF INERTIA AT HIGH SPIN. Sorensen, R.A. (Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). Rev. Mod. Phys 45: No. 3, 353-377 (July 1973).

The moment of inertia I of deformed nuclei increases with increasing angular momentum I in the ground–state rotational band. Recent energy measurements of rare–earth nuclei show that while the increase is smooth at low angular momenta, at about spin 14–16 in a number of nuclei there is a sudden substantial rise in the moment of inertia. In some cases I rises faster than I so that the rotational frequency $\omega = I/I$ actually decreases with increasing I producing a characteristic backbending I vs ω curve. A singular behavior at about these spin values was predicted over ten years ago by Mottelson and Valatin as a Coriolis antipairing effect. The present article will discuss the experimental data and describe calculations of the nuclear moment of inertia. Calculations made both before and after the recent experiments will be considered. (auth)

31635 CHOICE OF NUCLEON–NUCLEUS POTENTIAL IN THE CALCULATION OF OPTICAL POTENTIALS FOR COMPOSITE PROJECTILES. Simbel, M.H. (Department of Physics, Faculty of Science, Cairo University, Giza, Egypt). Phys. Rev. C 8: No. 1, 75-82 (July 1973).

The disintegration effects for deuterons, tritons, and helions (^3He) on their optical potentials are investigated in the framework of the adiabatic approximation. Using the eikonal approximation for the involved scattering amplitudes, it was possible to get analytic expression for the optical potentials of composite projectiles. The volume integrals of the resulting potentials are evaluated and compared with the corresponding quantities evaluated using the Watanabe model which neglects the disintegration of the projectiles. This comparison suggests that the disintegration of the projectile can be taken into account in the Watanabe model by an appropriate choice of the energy at which the nucleon potentials involved in the calculations are evaluated. An expression of this effective nucleon energy is given in terms of the volume integrals and mean square radii of the nucleon optical potentials. An extensive analysis of the energy and mass–number dependence of the phenomenological optical potentials of proton scattering at medium energies is given and used to evaluate the effective nucleon energy suggested in this work and to draw some conclusions on the validity of the extended optical model of Greenlees, Pyle, and Tang. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

Confinement and Heating

Refer also to abstracts 31718 and 31719.

31636 (IPP-IV-57) STOCHASTIC HEATING OF PLASMA ELECTRONS USING MICROWAVE NOISE. Puri, S. (Max Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jun 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

A mirror-contained hydrogen plasma of approximately 1 liter volume, 1×10^{11} cm^{-3} density, and 1 keV temperature is produced using 100-watt broadband microwave noise at the electron cyclotron resonance. In contrast to the single-frequency heating, noise heating is stable, repeatable, and more efficient. The use of Ioffe bars is found to be indispensable in suppressing the low-frequency instabilities and the attendant plasma loss, as well as for assuring reproducibility. Detailed density, diamagnetic, and energy-analyzer measurements are presented for several values of power input, noise bandwidth and gas pressure. Independent measurements of density and diamagnetic signal decay in the afterglow plasma are also given. (auth)

31637 (UCRL-51419) EFFICIENCY OF INJECTION OF HIGH-ENERGY NEUTRAL BEAMS INTO THERMONUCLEAR REACTORS. Hovingh, J.; Moir, R. W. (California Univ., Livermore. Lawrence Livermore Lab.). 17 Jul 1973. Contract W-7405-eng-48. 47p. Dep. NTIS $4.00.

The efficiency of injection of energetic, neutral beams into thermonuclear reactors has a substantial effect on the overall reactor efficiency. Direct conversion of the unneutralized portions of the ion beam is used in modeling the injector system, and the injection efficiency is estimated from assumptions on the performances of the components of the injection system. Based on this model, deuterium or tritium atoms between 100 and 1000 keV, which have been generated from negative ions, can be injected into the reactor with an efficiency of 80 to 90%. Without direct conversion this efficiency will drop to 65 to 85%. For energies around 100 keV, D^+ ions can be used to obtain a system efficiency of about 75%, which is higher than can be obtained with either D_2^+ or D_3^+. The same model predicts the injection of ^3He atoms to be 80% efficient below 200 keV using $^3He^+$ ions, and less than 70% efficient between 200 keV and 700 keV using $^3He^-$ ions. (auth)

31638 INJECTION OF A LASER-PRODUCED PLASMA INTO A MAGNETIC TRAP. Arifov, T.U.; Raevskii, I.M. Sov. Phys.–Tech. Phys. 17: No. 8, 1410-1412 (Feb 1973).

Results are given of experiments on the effectiveness of trapping of a laser-produced plasma in a mirror and a cusp. It is found that injection into a cusp leads to more effective trapping and containment of high-density plasma. (MOW)

31639 SHOCK WAVES IN AN ELECTROMAGNETIC SHOCK TUBE. Buzhinskii, O.I.; Volkov, L.P. Sov. Phys.–Tech. Phys. 17: No. 8, 1385-1389 (Feb 1973).

The electromagnetic generation of strong shock waves at normal pressure is studied by shadow photography. The experiments are carried out in air and in helium at a pressure of 730 mm Hg and 20°C. The undisturbed gas, the plasma, and the region of uniform flow behind the shock front are clearly delineated. Motion pictures of the initial stage of the shock and breaking away from the leading boundary of the plasma are shown. This method is found to be a useful laboratory procedure for obtaining shock waves with plane fronts. (auth)

31640 ADIABATIC COMPRESSION OF THE TOKAMAK DISCHARGE. Bol, K.; Ellis, R. A.; Eubank, H.; Furth, H. P.; Jacobson, R. A.; Johnson, L. C.; Mazzucato, E.; Stodiek, W. (Princeton Univ., NJ). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany. (26 Mar 1973).

The experimentally observed behavior of ATC compression is in general agreement with the idealized scaling laws in respect to plasma density, ion temperature, and total current, but not in respect to electron temperature. A comparison of plasma densities before and after compression shows reasonable agreement with the expected R^{-2} dependence. Compression of the discharge results in the induction of large eddy currents in the copper of the toroidal field windings which have lifetime of the order of several msec. It is difficult to make quantitative predictions of the current magnification, although the qualitative behavior is what one would expect for an ideal, flux-conserving plasma ring. (GE)

31641 MAGNETIC MULTIPOLE CONTAINMENT OF LARGE UNIFORM COLLISIONLESS QUIESCENT PLASMAS. Limpaecher, R.; MacKenzie, K.R. (Department of Physics, University of California, Los Angeles, California 90024). Rev. Sci. Instrum. 44: No. 6, 726-731 (June 1973).

Over 1200 Alnico magnets ($1.3 \times 1.3 \times 4$ cm) are used to contain a conventional discharge plasma produced by 1–20 A of emission from 6–48 small filaments at – 60 V. Densities up to 10^{12} ions/cm^3 are produced in argon at 2×10^{-3} Torr. At 5×10^{-6} Torr typical parameters are: 8×10^{10} ions/cm^3; $n_i/n_0 \simeq 0.7$; $T_e \simeq 5$ eV; $T_i \simeq 0.5$ eV; noise $< \delta n/n > \simeq 2 \times 10^{-4}$; and $< 1\%$ nonuniformity over a volume 31 cm diam by 69 cm. Uniform dense plasmas of He, D, and H are also produced. The ion containment appears to be both magnetic and electrostatic. (auth)

31642 PLASMA HEATING BY AN INTENSE RELATIVISTIC ELECTRON BEAM. Kapetanakos, C.A.; Hammer, D.A. (Naval Research Laboratory, Washington, D.C. 20390). Appl. Phys. Lett. 23: No. 1, 17-19 (1 July 1973).

A 400-keV 40-kA 50-nsec-duration relativistic electron beam is injected into a plasma confined in a magnetic mirror. It is found that the coupling efficiency of beam energy into the plasma at fixed magnetic field is optimum when the beam and plasma densities are comparable, and is independent of magnetic field, provided it exceeds 2.5 kG. (auth)

31643 STATIONARY SHOCKS AND TOROIDAL DIFFUSION. Greene, J.M.; Winsor, N.K. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 6, 863-870 (June 1973).

For a resistive plasma or stellarator of low-temperature tokamak type, the quasistationary equilibrium is rotating at the reduced sound speed $B_\theta v_{th}/B_z$, and has a slow (acoustic branch) shock fixed in space. Dissipation in the shock can increase plasma loss by an order of magnitude over the Pfirsch–Schlüter rate. For a very weak shock, the loss rate scales with the resistivity as $\eta^{4/3}$; for a stronger (but still weak) shock, it scales as $\eta^{3/2}$. On the diffusion time scale, flow along the lines of force must develop. (auth)

31644 ION CONTAINMENT IN AXISYMMETRIC MIRRORS IN THE PRESENCE OF FLUCTUATING ELECTRIC FIELDS. Catto, P.J. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Fluids 16: No. 6, 951-952 (June 1973).

A set of equations and resulting constraints are derived for ions contained in an axisymmetric mirror in the presence of a fluctuating electric field. These are in agreement with previous slab geometry results which imply that a confined distribution of particles still exists. (auth)

31645 SIMULTANEOUSLY PINCHED ELECTRON BEAMS. McClenny, W.A.; Bennett, W.H. (North Carolina State University at Raleigh, Raleigh, North Carolina 27607). J. Appl. Phys. 44: No. 8, 3557-3562 (Aug 1973).

Treated is the steady state of a beam interacting with the plasma which it produces in a low-density gas and in which magnetic self-focusing must be considered. Self-focusing is assumed to exist when the second time derivative of the moment of inertia of the beam electrons is negative and when that of the ions is neglected. Predictions are related to experiments with 10–15-keV beam electron energies, beam currents of several hundred milliamps, and system pressures of 10^{-4} Torr. Simultaneous pinching is observed with approximately equal radial forces on the beam electrons due to overneutralization and due to magnetic self-focusing. (auth)

31646 TEMPERATURE LAWS FOR LASER-THIN-TARGET INTERACTION. Bonnier, A.; Martineau, J. (INRS/ENERGIE Varennes, Québec, Canada). J. Appl. Phys. 44: No. 8, 3626-3630 (Aug 1973).

An integrated hydrodynamic inhomogeneous spherical model is used to describe the temporal evolution of thin targets under heating by a laser beam. Computer analysis gives temperature laws as a function of characteristic parameters of both target and laser beam. The results indicate a change in the scaling laws for such laser-created plasmas. (auth)

Diagnostics

Refer also to abstract 31686.

31647 DETERMINATION OF FIELD STRENGTH IN A MICROWAVE-PLASMA INTERACTION BY MEANS OF THE STARK EFFECT. Arkhipenko, V.I.; Budnikov, V.N.; Varfolomeev, V.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the

USSR, Leningrad). Sov. Phys.–Tech. Phys. 17: No. 8, 1311-1314 (Feb 1973).

An experimental determination of the amplitude of the electric fields in microwave absorption in a plasma is presented. The plasma is irradiated by 3-cm microwave power ($\omega_{He}/\omega = H/H_c = 0.86$), by means of circular waveguide in the H_{11} mode. The power is 100 W and the peak microwave electric field in the waveguide without plasma is 150 V/cm. In order to match it to the waveguide, the end of the plasma tube is conical in shape. The operating gas is hydrogen at a pressure of 2×10^{-2} torr. The half-width of the hydrogen lines Hα, Hβ, and Hγ are measured, making it possible to measure the temperature distribution of the radiating atoms and of the electric field over the length of the tube. The maximum value of the field in the plasma is 1.3 kV/cm. The region of intense field is located in the conical section and occupies a length of about 2 cm. (auth)

31648 SPECTROSCOPY OF A TURBULENT PLASMA. Yakovlev, D.G. (A. I. Ioffe Physicotechnical Institute). Sov. Phys.–Tech. Phys. 17: No. 8, 1248-1254 (Feb 1973).

An examination has been made of the shape of hydrogen lines radiated by a plasma in cases in which the Stark shift is much greater or much less than the mean frequency of the electric field. It is shown that in the first case the line shape can be used to calculate the moments of the electric field distribution; in the second case, the dispersion and mean frequency of the field can be determined. (auth)

31649 PROBE CHARACTERISTICS IN A PLASMA. Kononenko, K.I.; Pogrebnyak, V.A. (A. M. Gor'kii Khar'kov State University). Sov. Phys.–Tech. Phys. 17: No. 8, 1255-1257 (Feb 1973).

An investigation is made of probe characteristics and their relation to discharge current characteristics. The Boltzmann equation is solved to yield expressions for the probe characteristics when electron–electron collisions ν_{ee} dominate collisions of electrons with molecular ions $\bar{\nu}$, and vice versa. In the case $\nu_{ee} \gg \bar{\nu}$ the probe characteristic decreases monotonically; in the case $\nu_{ee} \ll \bar{\nu}$ it can exhibit a maximum. (auth)

31650 MEASUREMENT OF ELECTRON ENERGY DISTRIBUTION IN A PLASMA WITH PERIODICALLY VARYING PARAMETERS. Blagoev, A.B.; Kolokolov, N.B.; Milenin, V.M. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Tech. Phys. 17: No. 8, 1359-1362 (Feb 1973).

Circuits are described for measuring the electron energy distribution by modulation of the probe current which can be utilized to study a plasma with periodically varying parameters. The proposed circuits provide a possibility for carrying out investigations when there is an oscillating space potential and in a plasma with a high electron density. (auth)

31651 APPLICATION OF LASER INTERFEROMETERS TO MEASUREMENTS OF ELECTRON CONCENTRATION IN PLASMA. Appelt, J.; Sadowski, M. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 18: No. 7, 277-297(1973).

The physical principles of interferometric methods used for plasma diagnostics and the systems of conventional interferometers with laser sources and of laser three-mirror interferometers are described. The laser interferometers designed and constructed in the Hot Plasma Physics Laboratory are described, and the results of preliminary measurements performed with those devices are given. A comparison of different interferometric methods is performed, and various factors influencing the use of such methods are discussed. (auth)

31652 LOCAL MEASUREMENTS OF MHD STABILITY PROPERTIES IN THE ST TOKAMAK. Jobes, F. C.; Hosea, J. C. (Princeton Univ., NJ). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany. (26 Mar 1973).

The heavy (thallium) ion beam probe diagnostic enables one to scan through the hot tokamak plasma along a "detector line" in a time short relative to the characteristic discharge times. This diagnostic can measure, in principle, the instantaneous local values of electron density, current density and space potential, as well as perturbations of these quantities. Therefore, it is well suited for the study of the low-frequency oscillatory instabilities found to lead into the deleterious disruptive instability at the low-q and high-density limits to useful tokamak operation. Preliminary measurements with the heavy ion beam probe revealed that the low-frequency oscillatory instabilities observed previously with magnetic probes produce localized density perturbations in the vicinity of the q = m magnetic surface. (GE)

31653 FREQUENCY ANALYSIS METHODS IN THE EXPERIMENTAL STUDY OF CURRENT FLUCTUATIONS IN A PLASMA. Apukhovskii, A. Y. Sov. Astron. AJ (Engl. Transl.); 4: No. 4, 43-48(1971).

Translated from Avtomatika; 4: No. 4, 59(1971).

The possibility is considered of applying frequency-analysis methods and spectrum analyzers for investigation of spectrum composition in plasma current fluctuations. Proceeding from the fact that current fluctuations are random stationary processes with pronounced frequency components, the general case considered is the resonator behavior with purely random "white noise" input. Results are presented of processing oscillograms of current fluctuations in one of the installations. (Appl. Mech. Rev.)

31654 SPECTROMETRIC TECHNIQUES FOR THE STUDY OF ARGON AND NITROGEN PLASMAS PRODUCED IN WALL-STABILIZED ARCS. Beretta, F.; D'Alessio, A.; Diana, M.; Raso, G. (CNR, Naples). Termotecnica (Milan); 27: No. 8, 430-439(Aug 1973). (In Italian).

Some spectrometric techniques used for the study of cylindrical, optically thin, nearly thermal plasmas are briefly illustrated. Radial electron-temperature distributions in argon and nitrogen plasmas from the measurement of the Abel-inverted absolute intensities of atomic lines and the monochromatic continuum are evaluated; the ratios of lines and continuum intensities also are used. Axial electron densities are deduced from the half-width measurements of Stark-broadened atomic lines, and the distortion of the profiles, due to the plasma thermal inhomogeneity, is discussed. Some features of the molecular emission of nitrogen plasma are pointed out, and the possibility of measuring from them the heavy-particle temperature is examined. (auth)

31655 INVESTIGATION OF THE SPACE–TIME DISTRIBUTION OF THE OPTICAL DENSITY OF THE PLASMA IN HIGH–CURRENT LI–IN DISCHARGES. Vekhov, A.A.; Nikolaev, F.A.; Rozanov, V.B. High Temp. 10: No. 4, 655-658 (Mar 1973).

The method of absorption of the beam from a He–Ne laser (λ=6328 Å, radiation power 10 mW) was used to study the space–time distribution of the optical density of lithium and indium plasmas. It is shown that the optical density of the plasma pinch is nonuniform over its radius and has a maximum at a certain distance from the discharge axis. The model of the development of the discharge is discussed according to which the plasma has a maximum temperature at the center of the discharge. (auth)

31656 MEASUREMENT OF LOCAL VELOCITY VECTOR IN PLASMA FLOWS. Kozlov, N.P.; Leskov, L.V.; Protasov, Y.S.; Khvesyuk, V.I. High Temp. 10: No. 4, 792-793 (Mar 1973).

The direction of the local velocity vector can be measured by means of electrostatic probes operating under conditions of saturation ion current; the essence of the method is presented briefly. Having thus determined the direction of the velocity vector, the absolute value of the velocity can be obtained by measuring a single projection of the velocity by one of the known methods. (LMT)

31657 PROBE DEVICE FOR MEASURING LOCAL PARAMETERS OF IONIZED GAS FLOW. Kubarev, Y.V.; Krasnenkov, M.A.; Korshakovskii, S.I.; Matusevich, I.M. High Temp. 10: No. 4, 794-795 (Mar 1973).

An apparatus is described for measuring, in ~0.3s, the electron temperature in the range 3 to 20 eV, charged-particle density from 10^9 to 10^{15} cm^{-3}, and directional ion velocity of 5 to 100×10^3 m/s. The lower limits of ranges are determined by the resolving power of the device and the upper limits by the design features of probes and the duration of measurements. (LMT)

31658 DOUBLE PROBE IN A RECOMBINATIONAL PLASMA. Novikova, K.P. High Temp. 10: No. 4, 798-800 (Mar 1973).

A study is reported of the possible use of a double probe to measure T_e in a collisional plasma, in which the primary mechanism for the loss of charged particles is recombination in the plasma interior. The distributions of the electron and ion densities near an insulated electrode at a floating potential are found. (LMT)

31659 DETERMINATION OF PLASMA DENSITY IN A STELLARATOR USING AN OPEN MICROWAVE RESONATOR. Akulina, D.K.; Nechaev, Y.I.; Sud'enkov, V.Y.; Fedyanin, O.I. High Temp. 10: No. 4, 828-831 (Mar 1973).

The use of Fabry–Perot type resonators in stellarator chambers runs up against a number of difficulties associated with the need to position the resonator within the chamber without restricting its aperture, with the need to eliminate the reaction of the resonant properties of the chamber on the frequency characteristics of the resonator, and so forth. The broad-band character of the resonator excitation system, essential if plasma investigations are to be conducted over a wide range of densities, acquires particular significance. These problems have been solved in the resonator designed for plasma density measurements in the stellarators of the Physics Institute of the Academy of Sciences. The construction of the resonator is illustrated and its use is described. (LMT)

31660 PERTURBATION OF A PLASMA BY A FOCUSED CO_2 LASER BEAM. Kerr, R.D.; Smy, P.R.; Offenberger, A.A. (Department of Electrical Engineering, University of Alberta, Edmonton 7, Alberta, Canada). J. Appl. Phys. 44: No. 7, 3063-3065 (July 1973).

The perturbation introduced in a plasma by absorption of pulsed CO_2 laser radiation has been measured as a function of laser energy and plasma density using a piezoelectric probe. Results have relevance to CO_2 laser–plasma diagnostics and gas breakdown. (auth)

31661 RELATIVISTIC EFFECT IN THE LIGHT-SCATTERING SPECTRUM OF A θ-PINCH PLASMA. Gondhalekar, A.M.; Kronast, B. (National Research Council of Canada, Ottawa, Canada). Phys. Rev. A 8: No. 1, 441-445 (July 1973).

Precise measurements of incoherently scattered light from a θ-pinch plasma revealed a blue shift of the spectrum which could not be accounted for either by the diamagnetic drift velocity of the electrons or by the motion of the plasma as observed stereoscopically by a streak camera. We find that a major part of the blue shift can be attributed to a relativistic effect. We discuss the consequences of ignoring the relativistic corrections and point out the possibility of making large systematic errors in electron–temperature measurement in certain experimental arrangements employing Thomson scattering. Even at temperatures well below 1000 eV the effect is not negligible. (auth)

31662 LANGMUIR PROBE MEASUREMENT OF ELECTRON TEMPERATURE IN HIGH-PRESSURE PLASMAS. Clements, R.M. (Department of Physics, University of Victoria, Victoria, British, Columbia, Canada); Smy, P.R. J. Appl. Phys. 44: No. 8, 3550-3556 (Aug 1973).

The effect upon measurements of electron temperature in high–pressure plasmas of the cooling of the plasma electrons by the inherently cold layer of gas surrounding the probe has been investigated. Theoretical considerations indicate that while cooling effects can be substantial, accurate electron temperature measurements can be obtained if the probe is sufficiently small or is moved through the plasma at sufficient velocity. These conclusions are at variance with the calculations of some other workers but are in good agreement with experimental results reported in this paper. (auth)

31663 CAVITY PERTURBATION TECHNIQUE FOR DETERMINING THE PRESENCE OF MOLECULAR IONS OF HELIUM IN A DC DISCHARGE PLASMA. Congleton, M.W.; Freeman, R.H.; Roberts, J.A. (Department of Physics, North Texas State University, Denton, Texas 76201). J. Chem. Phys. 59: No. 2, 866-872 (15 July 1973).

A resonant cavity technique was employed as a probe to determine the presence of molecular ions of helium. The cavity resonance profile was displayed on an oscilloscope and the nature of the perturbation of this resonance observed to determine the nature of ions in a plasma filament placed coaxially within the cavity. The Slater perturbation technique for resonant cavities was employed to calculate relative ion abundances for each type of helium ion observed to be perturbing the resonant frequency of the cavity. The results of this work indicate that for specific currents, voltages and pressures, for a given geometry discharge tube, various molecular ions of helium can be produced and analyzed by the cavity perturbation technique. (auth)

Kinetics (General)

Refer also to abstracts 30740 and 31757.

31664 (CEA-R-4452) CONTRIBUTION TO THE STUDY OF A NONCYLINDRICAL FOCUSED ELECTRICAL DISCHARGE. Patou, C. (CEA Centre d'Etudes de Limeil, 94–Villeneuve Saint-Georges (France)). Sep 1973. 124p. (In French). Dep. NTIS (U.S. Sales Only) $8.25.

Thesis. Submitted to Paris Univ., Orsay (France).

The dynamics of a 15-kJ capacitor-bank-powered discharge and the characteristics of the x rays and neutrons emitted are described. The dynamics of the discharge is compared to the results of two different two-dimensional numerical codes: snowplow and magnetohydrodynamic. When the neutron emission is nearly isotropic, the electron temperature is measured from the x rays radiated by the plasma. For these discharges, x rays and neutrons are coming from the same regions of the plasma, and a thermonuclear origin of the neutrons cannot be avoided. When the initial gas pressure is lowered, the neutron emission becomes strongly anisotropic and difficult to study. (auth)

31665 COAXIAL PLASMA GUN IN MODE 1 OPERATION. Chen, Y. H.; Lee, S. (Malaya Univ., Kuala Lumpur, Malaysia). Int. J. Electron.; 35: No. 3, 341-352(Sep 1973).

Plasma focusing action is observed in two coaxial plasma guns, operating in deuterium in mode 1 operation, one with a nonconducting outer cylinder (gun A) and the other one with a conducting outer cylinder (gun B). For gun A, a limiting velocity of 4.5 cm/μsec in the steady-propagation region is measured but, despite this low velocity, focusing characteristics in voltage spikes and current dips are observed. This anomalous low velocity is in agreement with a snow-plough model including an ionization retarding force. An estimation of focus radius is made both from framing photograph and voltage spike and current dip, giving a value of 2.0 and 1.6 mm, respectively, for 360-kA input current at 0.3 torr. For gun B at a current of 540 kA and 1.3 torr ambient pressure, a focus radius of 0.7 mm is observed from soft x-ray photographs. The energy of the soft x-ray emission is estimated as between 0.8 and 2.5 keV. (auth)

31666 ELECTRON KINETICS OF WEAKLY IONIZED LORENTZ PLASMAS IN ARBITRARILY MUTUALLY ORIENTED EXTERNAL ELECTRIC AND MAGNETIC FIELDS. Winkler, R. (Zentralinstitut fuer Elektronenphysik, Greifswald, Ger.). Beitr. Plasmaphys.; 12: No. 6, 317-348(1972). (In German).

For the isotropic component in the velocity distribution function of electrons, a solution is found by numerical methods using the difference-differential equations which are derived from the Boltzmann equation with two-impact integrals describing the elastic and exciting impacts of electrons and atoms of neutral gases. The solution applies to an anisothermal neon plasma under homogeneous stationary conditions, to a wide range of electric and magnetic field strengths, as well as to different angles between electric and magnetic fields. In addition to the distribution function, the calculation yields the tensorial mobility, the tensorial diffusion coefficient, the mean kinetic electron energy, the impact frequency, and the energy loss. The results are used to discuss the influence of the Lorentz force. (HBG)

31667 MEASUREMENT OF THE REACTIVE FORCE OF PLASMA JETS. Ageev, L. I.; Belinskii, V. N.; Grishin, S. D.; Myasnov, N. I.; Ogorodnikov, S. N.; Pankratov, V. G. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 2, 205-206(Feb 1973).

Translated from Izmer. Tekh.; 16: No. 2, 32-33(Feb 1973).

One of the parameters of continuous-action plasma accelerators consists of the reactive force of a discharging jet. The operation and performance of a device for measuring the reactive force of such a jet are discussed. (MOW)

31668 DETERMINATION OF ELECTRON TEMPERATURE IN DIFFUSION-DOMINATED NON-LTE PLASMAS. Drawin, H. W.; Emard, F. (CEN, Fontenay-aux-Roses, France). Z. Naturforsch; 28a: No. 8, 1289-1293(1973).

Population densities of atomic hydrogen levels were calculated for homogeneous stationary and diffusion-dominated stationary plasmas. The results show strong overpopulation of the lower lying excited states when the actual number density of ground state atoms is larger than the density obtained for the homogeneous stationary state. At low electron and high ground state densities the so-called Boltzmann slope is not further a characteristic quantity for the determination of electron temperatures, since the slope constant changes with quantum number. The partial LTE condition for diffusion-dominated plasmas is reexamined. (GE)

31669 INTERACTION OF RELATIVISTIC ELECTRON BEAM WITH PLASMA IN A WAVEGUIDE. Nechaev, V. E. (Scientific Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 4, 613-621(1973). (In Russian).

Electromagnetic waves in a waveguide uniformly filled with plasma and a relativistic beam and having a strong axial magnetic field are considered. The dispersion characteristics are studied, and the conditions causing the beam instability are found. In the wave-amplification band the spatial increments are calculated, and the integral amplification of the current-beam fluctuations which defines a "stable" length is estimated. The peculiarities of using such systems in microwave electronics are considered. (auth)

Kinetics (Experimental)

31670 COLLISION PROCESSES OCCURING IN DECAYING PLASMAS PRODUCED IN HELIUM–HYDROGEN MIXTURES. Veatch, G.E.; Oskam, H.J. (Department of Electrical Engineering, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. A 8: No. 1, 389-396 (July 1973).

The time dependence of the densities of He^+, He_2^+, H^+, H_2^+, H_3^+, HeH^+, and He_2H^+ ions was measured in the afterglow period of plasmas produced in helium containing 0.01, 0.02, and 0.1% hydrogen for total gas pressures varying from 1 to 10 Torr. The rate constant for the ionization of H_2 by $He(2^3S)$ was found to be 5.2×10^{11} cm sec^{-1}. The studies resulted in the observation, for the first time, of the production of H_2^+ by mutual collisions between metastable hydrogen

molecules. The radiative lifetime of these molecules was measured to be 2.7 ± 0.2 msec. The occurence of several other collision processes was also established. The mobility of H_3^+ in helium was determined to be $\mu_0 = 40 \pm 0.5$ cm^2 (V sec)$^{-1}$. (auth)

31671 MEASUREMENT OF ELECTRON–ION RECOMBINATION RATE OF A DENSE HIGH–TEMPERATURE CESIUM PLASMA. Chen, C.J. (Jet Propulsion Laboratory, Pasadena, California 91103); Wu, J.M.; Wu, F.T.; Shaw, D.T. J. Appl. Phys. 44: No. 7, 3052-3054 (July 1973).

The result of the measurement of the electron–ion recombination rate of cesium plasma in a discharge tube is presented. The electron temperature has been extended to 5000 °K and the electron density to 10^{15} cm^{-3}. The comparison of the experimental data with the calculated values (Ref. 7) is considered to be satisfactory (auth)

Kinetics (Theoretical)

Refer also to abstract 31124.

31672 MOTION OF A CHARGED PARTICLE IN A TIME–VARYING AXIALLY SYMMETRIC MAGNETIC FIELD. Glikman, L.G. (Institute of Nuclear Physics, Academy of Sciences of the Kazakh SSR, Alma–Ata). Sov. Phys.–Tech. Phys. 17: No. 8, 1243-1247 (Feb 1973).

The motion of a charged particle in a time–varying axially symmetric magnetic field is considered using certain simplifying assumptions. Estimates are obtained for the dimensions of the region of allowed motion and for the energy of the particle. (auth)

31673 INERTIAL EMF DUE TO THERMAL CONVECTION IN A ROTATING PLASMA. Drobyshevskii, É. M. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 17: No. 8, 1262-1268 (Feb 1973).

The azimuthal component of the emf associated with thermal convection of a rotating plasma is determined. The calculations can be made with fairly general assumptions if the emf is represented in the form of an inertial emf proportional to the acceleration of the whole medium using the equation of motion of the ionized gas with known relations between the forces acting on each component of the gas. The Coriolis acceleration of the convection currents gives the main contribution to the generation of the rotational azimuthal emf. The resulting emf is proportional to the rotational velocity and the thermal flux transferrred by convection. The reasons for the apparent contradiction that arises in a comparison of the inertial emf and the emf produced by the gradients of the electron pressure are explained. (auth)

31674 ANGULAR DISTRIBUTION OF BREMSSTRAHLUNG FROM MIRROR–CONFINED ELECTRONS. England, A.C.; Haste, G.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. A 7: No. 2, 383-392 (Feb 1973).

The bremsstrahlung radiation from electron–ion collisions is emitted anisotropically in directions dependent on the electron kinetic energy and the photon energy. We consider here the radiation from electrons confined in magnetic mirrors. In particular, the magnitude of this anisotropy is examined as a function of the electron energy, the photon energy, the electron pitch angle, and the angle of a detector with respect to the magnetic–mirror midplane. The calculations are performed in the Born approximation with the cross sections developed by Gluckstern and Hull. We also compute the temperature of a bi–Maxwellian distribution from the slope of the log of the intensity vs photon–energy curve and consider the effects of pitch–angle distribution and detector angle on the anisotropy of the radiation. (auth)

31675 PLASMA DIFFUSION ACROSS A MAGNETIC FIELD DUE TO THERMAL VORTICES. Lee, Y.C. (University of California, Los Angeles, California, 90024); Liu, C.S. Phys. Rev. Lett. 30: No. 9, 361-364 (26 Feb 1973).

A convergent cross–field diffusion coefficient due to flute–type thermal fluctuations (vortices) is derived, taking into account the nonlinear, orbit–diffusion effect on the dynamic screening of the interaction and the fluctuation spectrum. Because of the finite–gyroradius reduction of the correlation, there is a region where the diffusion coefficient depends on B only logarithmically. (auth)

31676 HIGH FREQUENCY CONDUCTIVITY OF A MAGNETOPLASMA. Pytte, A.; Baird, A.M. (Department of Physics and Astronomy, Dartmouth College, Hanover, New Hampshire 03755). Phys. Fluids 16: No. 6, 943-943 (June 1973).

The conductivity is calculated with a convergent method requiring no cutoffs. The close collisions are treated quantum mechanically. (auth)

31677 ENERGY RECOVERY FROM ENERGETIC PLASMA STREAMS BY TRAVELING WAVES. Mirkin, M.I.; Briggs, R.J. (Department of Electrical Engineering and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Fluids 16: No. 6, 929-934 (June 1973).

An adiabatic theory of the energy exchange between magnetically confined charged particles and a traveling electrostatic wave with slowly varying phase speed and amplitude is presented. The results are applied to a basic assessment of the usefulness of traveling–wave techniques for efficient energy recovery from energetic plasma streams. Severe constraints on the energy conversion efficiency attainable by this approach are indicated by the model. (auth)

31678 TRANSPORT PROPERTIES OF A TOROIDAL PLASMA AT LOW–TO–INTERMEDIATE COLLISION FREQUENCIES. Hinton, F.L. (Center for Plasma Physics, The University of Texas, Austin, Texas 78712); Rosenbluth, M.N. Phys. Fluids 16: No. 6, 836-854 (June 1973).

The neoclassical plasma transport coefficients for axisymmetric toroidal magnetic confinement systems are calculated in the regime of low–to–intermediate collision frequency. The problem of solving the linearized drift kinetic equations, and calculating the transport coefficients, is formulated as a variational principle. A maximal form of the variational principle, which is valid in the low–to–intermediate collision frequency regime, is used in a numerical solution of the finite difference equations, to obtain the distribution function at points on a mesh in phase space. A new analytical result is used to check the accuracy of the numerical calculation for small collision frequencies; this is a correction to the asymptotic banana regime result, obtained from a Wiener–Hopf analysis of the boundary layer in phase space between the trapped and untrapped particle regions. An analytical correction to the plateau regime analytical result is also obtained. The transport coefficients are found to be monotonic functions of collision frequency, with a gradual transition from the banana regime to the plateau regime. Analytical formulas have been fitted to the numerically computed results. (auth)

31679 ENERGY LOSS OF CHARGED PARTICLES IN A PLASMA. Vriens, L. (Philips Research Laboratories, Eindhoven–The Netherlands). Phys. Rev. A 8: No. 1, 332-339 (July 1973).

Formulas for the stopping power of a nonrelativistic ionized gas for electrons, protons, and other structureless charged particles are derived. The primary velocities considered extend from values comparable to those of the plasma electrons up to values in the relativistic range. New results are obtained for the lower primary velocities, in that full account is taken of the effect of the initial velocity distribution of the plasma electrons on binary collisions as well as on collective excitations. Formulas for the case of non–negligible damping of plasma oscillations are given and comparisons are made with the impact–parameter method and with particle kinetic theories. (auth)

31680 X–RAY EMISSION IN LASER–PRODUCED PLASMAS. Colombant, D.; Tonon, G.F. (Commissariat à l'Energie Atomique, Centre d'Etudes de Limeil, B.P. N° 27–94190–Villeneuve–Saint–Georges, France). J. Appl. Phys. 44: No. 8, 3524-3537 (Aug 1973).

Numerical results are presented for the characteristics of heavy–ion laser–produced plasmas. A conversion ratio defined as x–ray power/absorbed power is then computed. Collisional–radiative equilibrium is assumed for the ionization model. In the case of low radiation emission, a relation between laser flux and plasma temperature is derived. The one–dimensional geometrical model is then corrected in the expansion by assuming that the emission occurs, in fact, over a length L only. Results are given and compared with experimental ones. The influence of the laser wavelength is also discussed and conclusions on the possible applications of these laser–produced plasmas are drawn. (auth)

31681 KINETIC MODEL OF ULTRAVIOLET INVERSIONS IN HIGH–PRESSURE RARE–GAS PLASMAS. George, E.V. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Rhodes, C.K. Appl. Phys. Lett. 23: No. 3, 139-141 (1 Aug 1973).

It is shown theoretically that stimulated vacuum ultraviolet emission at $\sim$ 1700 Å is possible in the afterglow of a suitably prepared ionized xenon plasma. Our model involves the dissociative recombination of Xe^+_2 as a key step in the kinetic scheme leading to the production of excited Xe^*_2 dimers. It is found that the maximum value of the dimer population occurs for a plasma that is initially $\sim$ 1% ionized with cold gas atoms. Both plasma heating and higher levels of ionization inhibit dimer formation. Excited state–excited state loss channels are also seen to play an important role in limiting the peak dimer density. Comparison of this theory with recent experimental results involving relativistic electron–beam–excited plasmas is good. (auth)

Production

31682 (IPP–IV–47) CONTINUOUS DROPLET SOURCE FOR PLASMA PRODUCTION WITH PULSE LASERS. Schwenn, U.;

Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). May 1973. 23p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

The principle of a continuous droplet source for plasma production with a repetitively pulsed laser is described. A prototype was successfully operated with water. (auth)

31683 (LA-5318) EFFICIENT ILLUMINATION OF A SPHERE. Beyer, W. A.; Ryan, R. J.; Adler, F. T. (Los Alamos Scientific Lab., N. Mex.). Sep 1973. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

A sphere is to be illuminated as uniformly as possible by N incident beams of light, each beam being directed radially on the sphere and the diameter of the cross section of the beam being equal to the diameter of the sphere. The beams are assumed to be of the same intensity. Two functions measuring the uniformity of the illumination are proposed: F_N, being the maximum of the absolute value of the intensity on the sphere minus the average intensity on the sphere; and the function, F_N^2, being the square root of the integral over the sphere of the square of the deviation of the intensity from the average intensity. Certain cases are discussed analytically, others computationally. Results from the problem of Tammes relevant to this problem are summarized. Tammes configurations are suggested as providing favorable configurations in the absence of analytical or computational results. It is concluded that N = 5 and 6 should be avoided. For N = 4 the best arrangement for the beams seems to be at the vertices of a regular tetrahedron circumscribed about the sphere; for N = 8, the vertices of a circumscribed antiprism seem to be almost the best. (auth)

31684 MOMENTUM TRANSFER TO LASER-IRRADIATED TARGETS, INDICATING THE NONLINEAR INTERACTION FORCE. Hora, H. (Max-Planck-Institut für Plasmaphysik, Garching, Germany). Appl. Phys. Lett. 23: No. 1, 39-40 (1 July 1973).

Measurements by Metz of the momentum ρ transferred to laser-irradiated targets are evaluated and compared with the results of the nonlinear force of laser-plasma interaction. The measured thresholds for the intensity I^*, estimated to be 2×10^{14} W/cm^2, agree with the threshold of the nonlinear force. The measured highly superlinear relation $P \simeq I^4$ agrees very well with the theory for not too large intensities $I \gtrsim I^*$. A consequence would be an electron energy of coherent oscillation near 10^4 eV, which may cause a nonthermal origin of fusion neutrons in other experiments. (auth)

31685 DENSE PLASMA DISCHARGES FOR SOLID-TARGET HEATING. Vitkovitsky, I.M.; Levine, L.S.; Mosher, D.; Stephanakis, S.J. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 23: No. 1, 9-11 (1 July 1973).

Dense plasma channels formed by exploding-wire discharges have been used to form very-high-current-density electron beams. The interaction of the beam with the plasma lowers the mean electron energy relative to that to be gained in the accelerating potential of 10^6 V applied across the plasma. The current density of electrons incident on the anode and their energy distribution have been determined. Approximately 10% of the current at the anode contains electrons with energy greater than 25 keV. The current density associated with these electrons exceeds 10^7 A/cm^2. The power delivered to the anode approaches 10^{12} W/cm^2, which leads to strong anode heating. X-ray spectroscopy of the radiation emitted from the anode and of neutron production in deuterated anodes was used to deduce a target temperature of 0.1-1.0 keV. (auth)

31686 PLASMA CREATION FROM THIN ALUMINUM TARGETS BY A TEA-CO_2 LASER. Dick, K.; Pépin, H.; Martineau, J.; Parbhakar, K.; Thibaudeau, A. (INRS-Energie, Université du Québec, C.P. 1020, Varennes, Québec, Canada). J. Appl. Phys. 44: No. 7, 3284-3293 (July 1973).

The results of a study of the plasma produced by focused TEA-CO_2 laser radiation on aluminum foil targets are presented. Streak photography, interferometry, and charge collection measurements are used to describe the time and space evolution of the plasma. A maximum plasma temperature of 30 eV, deduced from the ion expansion energy, was obtained for an incident flux of 10^{10} W/cm^2. The electron density remained below cutoff throughout the interaction. For thick targets the plasma production can be described by using a self-regulating process. For thin foils the plasma becomes transparent during the laser pulse and the hydrodynamic expansion can influence the results. In this latter case temperature scaling laws based on an integrated inhomogeneous spherical model give good agreement with the experiment. (auth)

31687 INFLUENCE OF A TRANSVERSE ELECTRIC FIELD ON LASER-INDUCED GAS BREAKDOWN. Tulip, J.; Seguin, H. (Department of Electrical Engineering, The University of Alberta, Edmonton 7, Canada). Appl. Phys. Lett. 23: No. 3, 135-136 (1 Aug 1973).

The threshold for laser-induced breakdown has been found to be influenced by an electric field transverse to the laser focus. In air at a pressure of 20 Torr a field strength of 600 V/cm was found to completely suppress breakdown. At higher field strengths the electric field was found to induce breakdown rather than suppress it. These effects are explained as being due to charge removal and electron cascade. (auth)

31688 SIMILARITY PRINCIPLES FOR LASER-INDUCED BREAKDOWN IN GASES. Yablonovitch, E. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Appl. Phys. Lett. 23: No. 3, 121-122 (1 Aug 1973).

The well-known similarity principles for dc breakdown in gases are extended to the case of laser-induced breakdown. The wealth of experimental data on kinetic processes in gases may therefore be directly applied to ac breakdown. Without solving the Boltzmann equation, the ionization rate is determined as a function of pressure, frequency, electric field, etc. This has important implications for the maximum possible light intensity in high-pressure TEA amplifiers. (auth)

Stability

Refer also to abstracts 31652, 31675, and 31720.

31689 (AD-759276) LITERATURE SURVEY ON PLASMA INSTABILITIES COVERING 1971 PUBLICATIONS. Part 1. Abstracts 1-217. Auer, G.; Cap, F.; Shukla, P. (Innsbruck Univ. (Austria)). 31 Dec 1972. Contract F44620-72-C-0016. 436p. (UNICP-SR-94; AFOSR-TR-73-489). NTIS.

The report is the first part of the literature survey on plasma instabilities covering the year 1971. This volume contains 217 abstracts, 68 survey reports on single instabilities, another report and a list of instabilities. (auth)

31690 (CLM-R-124) THERMODYNAMIC STABILITY OF COLLISIONLESS PLASMAS. Minardi, E. (UKAEA Research Group, Abingdon. Culham Lab.). May 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

The stability of Vlasov's equilibria (in general nonMaxwellian and inhomogeneous) can be described by a theory with a thermodynamic structure. This is achieved starting from a plasma model in which a given collective equilibrium, described by a time-independent solution of the Vlasov equation, is superimposed on a homogeneous plasma background. This background possesses random fluctuations of the density to be ascribed to its particle structure without individual interactions. The plasma is considered as a statistical assembly of identifiable volume elements which are functions of relevant random variables (called information variables) that describe the plasma configuration (e.g., the charge or the current density). These variables are formed by a random fluctuating part and a given collective part, fixed by the particular collective equilibrium under consideration. It is assumed that this equilibrium can be specified independently from the effects related to the random fluctuations of the underlying medium. This fact is expressed by imposing two independent constraints on the statistical system in such a way that it is characterized by two quantities, the mean square deviation of the information variable, which essentially represents the random effects of the background, and the collective energy of the Vlasov equilibrium. By means of this procedure the entropy of a collisionless equilibrium and the other thermodynamic potentials can be calculated. An equilibrium is declared unstable if neighboring equilibria can be reached, with a given thermodynamic process, such that the entropy increases while the system remains isolated. In this way sufficient criteria for instability can be obtained, which depend on the particular thermodynamic process under consideration (for instance dissipative processes, isothermal processes and so on). In all cases where an analytical computation is possible (i.e., for not too inhomogeneous equilibria) the thermodynamic criteria are shown to contain the instability criteria of the dynamics (MHD principle, Penrose criterion etc.) while, for inhomogeneous situations, new instability conditions are obtained. A sufficient criterion for instability with respect to dissipative processes, derived with the above thermodynamic method, was recently verified by computer calculations both in the cases of an electrostatic or a gravitational strongly inhomogeneous Vlasov's equilibrium. When the entropy of a collisionless system is known, the equilibria which are preferably chosen by the system can easily be determined because they must correspond to those values of the parameters for which the entropy is higher. A general property which follows from the thermodynamic approach is that an unstable, nearly homogeneous nondissipative collisionless system tends towards the marginally stable state. This statement replaces the so-called H-theorem which holds in the collisional systems. The application of the thermodynamic method to various cases of electrostatic or

magnetic Vlasov equilibria shows that it constitutes a powerful tool for globally describing the stability of a homogeneous or inhomogeneous collisionless plasma, independently from any detailed dynamical model. However, this is accomplished at the cost of neglecting the detailed dynamical behavior. (auth)

31691 (IPP-6/120) CALCULATION OF MHD EQUILIBRIA BY FOURIER ANALYSIS. Pohl, F. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jul 1973. 77p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

A FORTRAN code is given for solving axisymmetric MHD equilibria where pressure and toroidal field (times r) are arbitrary functions of the poloidal flux. Examples are presented that allow two or more solutions. These solutions are obtained by appropriately choosing the upper and lower limits of the FOURIER components of the flux function, which must be given on a circular or elliptic boundary curve. (auth)

31692 EXPERIMENTAL INVESTIGATION OF KINETIC INSTABILITIES IN THE GABOR MAGNETRON. Farenik, V.I.; Vlasov, V.V.; Rozhkov, A.M.; Stepanov, K.N.; Suprunenko, V.A. (A. M. Gor'kii Khar'kov State University). Sov. Phys.–Tech. Phys. 17: No. 8, 1298-1300 (Feb 1973).

The effect of kinetic instabilities is investigated on the cutoff current of a classical Gabor magnetron with a cathode on the periphery. The effect of centrifugal–beam and cyclotron resonance instabilities is studied. Correlation measurements of the anode currents and the amplitude of the unstable oscillations and the particle flux leaving the interaction space are presented. It is shown that when plasma instabilities develop in the plasma of a Gabor magnetron the anode current of the magnetron is nonzero for values of the magnetic field considerably greater than the critical value given by the Hull cutoff condition. When cyclotron instabilities occur, an increase is observed in both the anode current and the current along the magnetic field. (auth)

31693 PARAMETRIC EXCITATION OF HIGH–FREQUENCY ELECTROSTATIC OSCILLATIONS IN A COLD MAGNETOACTIVE PLASMA BY AN ELECTROMAGNETIC WAVE. Pustovalov, V.V.; Romanov, A.B. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 17: No. 8, 1315-1321 (Feb 1973).

Expressions are found for the growth rates, threshold fields, and critical fields for parametric excitation of electrostatic oscillations of a magnetoactive plasma at the lower and the upper hybrid frequencies by a wave of finite length. The parametric excitation is due to the decay of the high–frequency transverse (nonelectrostatic) pump wave into a transverse wave and an unstable electrostatic oscillation. The disposition of the vectors in the problem — the wave vectors of the excited and the external waves, the field vectors of the constant homogeneous magnetic field, and the electric field of the external wave — most favorable for excitation is found. The threshold values of the electric field are determined by the frequencies of electron–neutral and ion–neutral collisions. (auth)

31694 STABILITY OF A PLASMA WITH NONEQUILIBRIUM IONS WITH RESPECT TO MAGNETOSONIC WAVES. Sinitsa, N.G. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 17: No. 8, 1258-1261 (Feb 1973).

The conditions under which a dense plasma with nonequilibrium ions becomes unstable and generates magnetosonic waves are found. The resonance damping factors are found for magnetosonic waves at the first and higher harmonics of the ion gyrofrequency. (auth)

31695 ELECTROMAGNETIC ENERGY IN THE TWO–STREAM INSTABILITY IN A MAGNETIZED PLASMA. Aronov, B.I.; Rukhadze, A.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 17: No. 8, 1283-1286 (Feb 1973).

The excitation of electromagnetic waves by a relativisitic electron beam in a magnetoactive plasma in a metal waveguide is studied. In a magnetized plasma, as in an isotropic plasma, of all the electromagnetic waves excited by the beam, the greatest growth rate occurs for quasilongitudinal electrostatic waves. As a result, it is possible to determine the amplitude of the nonlinear wave and to calculate the Poynting vector in a magnetized plasma that supports the two-stream instability. (auth)

31696 INSTABILITY IN THE LONGITUDINALLY BOUND PLASMA-ELECTRON STREAM SYSTEM. Mamedov, M. A.; Fedorchenko, A. M. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 11, 1982-1983(Nov 1972).

Translated from Radiotekh. Elektron.; 17: No. 11, 2461-2462 (Nov 1972).

The instability of an electron stream that interacts with the cold uniform electron plasma included between the cathode and the anode is studied. The electron stream with a given density and speed v_0 is formed in the plane of the cathode, perpendicular to the direction of its movement, and is absorbed in the plane of the anode which is a distance L from the cathode. Assuming the potentials of the cathode and the anode to be fixed, the boundary conditions for the electric potential, perturbed density and speed of the electron stream can be written in the form $\phi(0) = \phi(L) = 0$, $n(0) = 0$, $v(0) = 0$. (MOW)

31697 PARAMETRIC EXCITATION OF A PURELY GROWING INSTABILITY IN AN UNMAGNETIZED PLASMA. Lee, K. F. (Chinese Univ. of Hong Kong, Shatin). Phys. Lett.; 44A: No. 5, 345-346(2 Jul 1973).

It is shown that, in an unmagnetized plasma subject to an externally driven uniform electric field, a purely growing instability associated with perturbations perpendicular to the direction of the external electric field can be excited. (auth)

31698 INABILITY OF ELECTRON TRAPPING TO STABILIZE THE ION ACOUSTIC INSTABILITY. Manheimer, W.M. (Naval Research Laboratory, Washington, D. C. 20390). Phys. Fluids 16: No. 6, 945-946 (June 1973).

It is shown that electron trapping does not stabilize the ion acoustic instability in an unmagnetized two– or three–dimensional plasma. Specifically, it is shown that for nearly all resonant particles, the correlation time is much less than the trapping time. (auth)

31699 ELECTROMAGNETIC ION STREAMING INSTABILITY. Vithal, K.L.; Tandon, J.N. (Center for Advanced Study in Physics, University of Delhi, Delhi–7, India). Phys. Fluids 16: No. 6, 947-948 (June 1973).

The instability of electromagnetic linearly polarized waves is discussed for a system composed of two identical counterstreaming ion beams in a uniform background of relatively stationary electrons. (auth)

31700 COLLISIONLESS DISSIPATION OF A CROSS–FIELD ELECTRIC CURRENT. Biskamp, D.; Chodura, R. (Max–Planck–Institut für Plasmaphysik, Garching b. München, Federal Republic of Germany). Phys. Fluids 16: No. 6, 893-901 (June 1973).

A detailed analysis is given of the development of the electrostatic turbulence excited by a cross–field current in a high density ($\omega_{pe} \gg \Omega_e$) collisionless plasma, as obtained from one– and two–dimensional computer simulations. The drift velocity required for instability is found to be only slightly smaller than the critical drift for the unmagnetic two–stream instability in contrast to the electron cyclotron drift instability. In one dimension the system remains self–similar in the turbulent phase, $\langle \tilde{E}^2 \rangle / 8\pi n T_e \simeq$ const, while the electron thermal velocity and the effective collision frequency increase linearly with time, $\nu^* \propto \Omega_e t$, in agreement with the theory of coherent trapped–electron heating by Forslund, Morse, and Nielson. The switch–off drift velocity, however, is $v_d \simeq 2c_s$, and hence the thickness of a magnetic sheath would be $\Delta \approx c/\omega_{pi}$ instead of $\Delta \approx c/\Omega_i$. In two dimensions two projections are investigated, the j–B plane and the plane perpendicular to B, the latter being the more relevant. The heating is much less efficient than in one dimension, $\nu^* \lesssim 5 \times 10^{-3} \omega_{pe}$. It is found that $\nu^* \propto \langle \tilde{E}^2 \rangle / 8\pi n T$, indicating stochastic dissipation. The gross features of the two–dimensional behavior correspond to the picture of ion–sound instability with electron runaway prevented by gyration. (auth)

31701 STABILITY OF AN UNNEUTRALIZED RIGIDLY ROTATING ELECTRON BEAM. Wong, H.V.; Sloan, M.L.; Thompson, J.R.; Drobot, A.T. (Austin Research Associates, Inc., Austin, Texas 78705). Phys. Fluids 16: No. 6, 902-903 (June 1973).

An unneutralized rigidly rotating electron beam is absolutely stable if the distribution function is a monotonically decreasing function of $H_0 - \omega_L L_z$ and if $(\rho_b \omega_r / c) < 1$, where H_0 and L_z are the single–particle energy and canonical angular momentum, ω_L is the angular velocity, and ρ_b is the radius of an enclosing infinitely conducting cylindrical wall. (auth)

31702 HOLLOW EQUILIBRIUM AND STABILITY OF A RELATIVISTIC ELECTRON BEAM PROPAGATING IN A PREIONIZED CHANNEL. Lee, E.P.; Pearlstein, L.D. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 16: No. 6, 904-908 (June 1973).

A short pulse of relativistic electrons propagating along a preionized channel of high conductivity may assume a hollow equilibrium profile as a result of induced plasma currents. In this configuration the pulse is neutrally stable with respect to lateral expulsion from the channel by the induced currents. The properties of a thin hollow shell equilibrium are derived. (auth)

31703 ASYMPTOTIC BEHAVIOR OF THE TWO–STREAM INSTABILITY. Biskamp, D.; Chodura, R. (Max–Planck–Institut für Plasmaphysik, 8046 Garching, b. München Federal Republic of Germany). Phys. Fluids 16: No. 6, 888-892 (June 1973).

The asymptotic of self–similar behavior of the one–dimensional two–stream instability previously observed in numerical simulations is investigated theoretically. The main result, the relation $v_d = v_e$, implies a principle of maximum dissipation. On the microscopic level it is shown that the quasilinear solution is inconsistent with $v_d = v_e$ and the

assumption of an adiabatically growing Bernstein–Greene–Kruskal wave cannot explain the observed similarity law. It is proposed that the observed behavior is due to the instability of a Bernstein–Greene–Krusal wave. Suitably chosen simulation computations are performed to demonstrate this concept. (auth)

31704 CRITICAL SHEAR AND GROWTH RATES FOR DRIFT WAVES IN A NONUNIFORM CURRENT–CARRYING PLASMA. Gladd, N.T.; Horton, W. Jr. (Center for Plasma Physics and Thermonuclear Research, Department of Physics, The University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 16: No. 6, 879-887 (June 1973).

From numerical and analytical solutions of the normal mode equation for drift waves in a sheared magnetic field, the critical shear S_c for the onset of instability and the normal mode growth rates at subcritical shear are obtained. At low beta and without a parallel current it is shown that approximately twice the previously indicated shear is required for stability and the $(m_e/m_i)^{1/3}$ scaling of S_c is confirmed. The addition of a parallel plasma current is shown to increase initially the critical shear quadratically with current and then linearly at larger currents. The effect of electron and ion temperature gradients is studied with equal density and temperature gradients resulting in aproximately a 50% reduction in S_c. Finally, the effect of finite beta on the critical shear is studied. (auth)

31705 MODEL EQUATIONS FOR MODE COUPLING SATURATION IN UNSTABLE PLASMAS. Ott, E.; Manheimer, W.M.; Book, D.L.; Boris, J.P. (Naval Research Laboratory, Washington, D. C. 20375). Phys. Fluids 16: No. 6, 855-862 (June 1973).

Some simple one–dimensional model equations for instability saturation by resonant mode coupling which are of the general form $\partial u/\partial t + \sigma_1 u\, \partial u/\partial x + M[u] = 0$, where $M[u] = i/2\pi \int dk\, \omega(k)\, dx'\, u(x') \exp[k(x-x)]$ are examined theoretically and numerically. For nondispersive $\omega(k)$, it is found that the temporal evolution is characterized by the formation and merging of shocks. Also, the level of saturation can depend on the physical size of the unstable system. If dispersive effects are strong, the solution is characterized by the formation of solitons. (auth)

31706 EXPERIMENTAL STUDY OF INSTABILITY OF HEAVY–CURRENT DISCHARGE IN OPEN–ENDED TUBE WITH EVAPORATING WALLS. Golubev, E.M.; Ogurtsova, N.N.; Podmoshenskii, I.V.; Rogovtsev, P.N. High Temp. 10: No. 4, 651-654 (Mar 1973).

An experimental study is made of the instability of a heavy–current evaporating–wall discharge in tubes open at their ends to the atmosphere. The lengths of the 50 mm diam. tubes range from 100 to 400 mm. The single pulse of current, of amplitude 100–250 kA and duration 200 μsec, is produced by discharging a capacitor bank. The investigations included: high–speed photography of the space–time development of the discharge, oscillographic measurement of the electric–field intensity in the plasma column with the aid of E–probes, estimation of the diameter of the current channel of the discharge from the erosion spot produced on a copper diaphragm, and a study of the influence on the stability of the discharge of tube length and the magnitude of the discharge current. The results of the investigations are in good agreement amongst themselves and clearly indicate hydromagnetic instability of the discharge. (auth)

31707 REPEATED–CASCADE THEORY OF TURBULENCE IN AN INHOMOGENEOUS PLASMA. Tchen, C.M. (The City College of the City University of New York, New York, New York 10031). Phys. Rev. A 8: No. 1, 500-514 (July 1973).

Turbulent–plasma phenomena in laboratories and in the ionosphere are often associated with plasma inhomogeneities. As a plasma inhomogeneity, we consider a partially ionized gas with a mean density gradient in a nonuniform mean electric field and a strong magnetic field. Because of drift instabilities, the plasma becomes turbulent in the plane transverse to the magnetic field. We propose a method of a repeated cascade, and derive the spectral distributions for the turbulent density and field fluctuations in the production, inertia, and dissipation subranges of the universal spectrum. The results predict k^{-3}, k^{-1}, and k^{-5} laws in the respective subranges for the density spectrum, and a single k^{-3} law for the field spectrum. As the plasma inhomogeneity may be embedded in an atmospheric turbulence, we also study the effect of the atmospheric turbulence which drives the plasma inhomogeneity. The theoretical predictions are found to agree with data from laboratory plasma experiments. (auth)

Thermonuclear Engineering and Equipment

31708 (CONF-730301-P2, pp 1035-1036) PHOTONEUTRON PRODUCTION IN SHIELDS FOR INTENSE (d–t) NEUTRON SOURCES. Bowman, C. D. (National Bureau of Standards, Washington, DC). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The role of photonuclear processes in the design of shielding for thermonuclear reactors is briefly discussed. (MOW)

31709 (IPP-9/12) PLASMA–WALL INTERACTION WITH INSULATORS. Haas, G. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jun 1973. 15p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Experimental results relating to the interaction between a hot experimental plasma or a fusion reactor plasma and an insulator are surveyed. Special attention is given to mechanical damage due to neutron radiation, erosion due to sputtering and similar processes, taking up and release of gas, and the macroscopic effects of thermal stress. At the present level of technology, the sensitivity of high-temperature-resistant insulators to neutron radiation seems to rule out their use in the blanket of a D–T fusion reactor. On the other hand, the difficulties arising from the other interactions can most likely be solved. This study is therefore primarily intended for large experimental facilities for investigating plasmas with long-confinement time, which approach fusion conditions. (auth)

31710 (LA-5399-P) LONG CONFINEMENT EXPERIMENT (LCE) PROPOSAL. Marder, B. M.; Siemon, R. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

By combining the straight theta-pinch geometry and the toroidal $l = 1,0$ geometry, it should be possible both to heat and to stably confine a high-β plasma. The benefits of such an approach are discussed and experiments are proposed. (auth)

31711 HIGH-CURRENT ELECTRON GUN FOR OPERATION IN POWERFUL MAGNETIC FIELDS. Bredikhin, M. Yu.; Maslov, A. I.; Skibenko, E. I.; Yuferov, V. B. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 373-375(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 34-36(1973).

Structural features and test results of a powerful electron gun designed for performing experiments in beam–plasma interaction are described. (auth)

31712 HIGH CURRENT PLASMA SOURCE. Ehlers, K. W.; Kunkel, W. B.; Baker, W. R. (to United States Atomic Energy Commission). US Patent 3,760,225. 18 Sep 1973. Filed date 6 Jun 1972. 6p.

A plasma source is described in which a plurality of sturdy filaments are distributed around the perimeter of a truncated cylindrical discharge chamber. A small-area anode is situated axially at one end of the chamber with an accel–decel extraction grid system at the other end. A high-current electron discharge pulse is established between the filaments and anode and a puff of gas is directed past the anode into the discharge chamber to be ionized to form an arc plasma from which a high current beam is extracted and directed by the extractor grids. The output contains a high proportion of energetic neutrals suitable for use in fueling a fusion reactor or other purpose. (Official Gazette)

31713 FUSION RESEARCH WITH LASERS. Breuer, G. Naturwiss. Rundsch.; 25: No. 8, 346-348(1973). (In German).

A general representation of the technical principles and problems of a laser-heated fusion reactor is given; in particular, the so-called "inertial" type with falling D–T spherules is explained. A further problem is the development of the corresponding high capacity lasers (e.g. iodine lasers). Finally, the relevant research in different countries (especially USA, USSR) is reported. (GE)

31714 WORLD SURVEY OF MAJOR FACILITIES IN CONTROLLED FUSION RESEARCH: 1973 EDITION. Nucl. Fusion; Special Suppl.: 1-356(1973).

The devices are first grouped by country and then by type. In the first part, the countries are listed in alphabetical order, in the second part the grouping by type is somewhat arbitrary and intended to provide an approximate guide rather than a definitive classification scheme; alphabetical order of the countries is, however, kept within each category of device. (auth)

31715 ELECTRON BEAM GENERATOR. Kelly, J. G. (to United States Atomic Energy Commission). US Patent 3,760,286. 18 Sep 1973. Filed date 18 Oct 1972. 8p.

An electron beam generator in which an annular sheath of electrons is produced by an annular cathode and anode arrangement and injected in a converging manner to a focal point with a portion of the beam current returned to the center of the converging beam and through the center of the cathode annulus. Another portion of

the beam current is fed back around the exterior of the converging beam. (Official Gazette)

31716 V-I CHARACTERISTICS OF PULSED CO_2 LASER DISCHARGES. Denes, L.J.; Lowke, J.J. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). Appl. Phys. Lett. 23: No. 3, 130-132 (1 Aug 1973).

The voltage-current dependence is investigated for pulsed self-sustained uniform-glow discharges by using commerical-grade mixtures of CO_2, N_2, and He at near-atmospheric pressures. For a given mixture, the discharge is found to stabilize at a value of E/N which is independent of discharge current density, total pressure, and electrode spacing; E is the electric field and N is the number density of the gas. We interpret these observations as evidence that the glow condition is effectively controlled by attachment to CO_2 and also to H_2O, a gaseous impurity. Calculations of the E/N characteristic, based on a model which includes recombination and attachment losses, are in agreement with experimental results for all mixtures studied. (auth)

Wave Phenomena

Refer also to abstracts 31030, 31680, and 31695.

31717 (IPP-IV-59) SLOW-WAVE COUPLING TO THE LOWER HYBRID RESONANCE. Puri, S.; Tutter, M. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jul 1973. 56p. Dep. NTIS (U. S. Sales Only) $5.00.

Previously it was shown that in a cold, inhomogeneous, magnetized plasma half-space, the lower-hybrid resonance is accessible to the transverse-magnetic (TM) plane waves incident on the vacuum/plasma interface at an approximately grazing incidence, provided that at the hybrid layer $\omega_{pe}/\omega_{ce} \lesssim 0.4$. These results are extended to the slow-wave case when n_z, the refractive index in the static magnetic field direction, exceeds unity. It is found that the plasma is indeed accessible to the slow waves if Golant's accessibility criterion $n_z > 1 + (\omega_{pe}/\omega_{ce})^2$ is satisfied, even though the computed plasma surface impedance is in wide variance with the Golant's results. The following recommendations can be made for coupling rf energy to the lower-hybrid resonance: (i) if $\omega_{pe}/\omega_{ce} \lesssim 0.4$, efficient coupling is possible by launching TEM-like waves on the plasma column, (ii) if $\omega_{pe}/\omega_{ce} \gtrsim 0.4$ and if the transverse machine dimensions exceed the rf vacuum wavelength, it is possible to couple TM waves using passive slow-wave structures inside the machine walls; and (iii) if $\omega_{pe}/\omega_{ce} \gtrsim 0.4$, but for smaller machine dimensions, recourse must be taken to transverse-electric slow-wave coupling with current carrying coils of appropriate periodicity. (auth)

31718 EXCITATION OF ELECTROMAGNETIC WAVES IN A PLASMA BY LONGITUDINAL ELECTRIC FIELDS. Longinov, A.V. Sov. Phys.-Tech. Phys. 17: No. 8, 1273-1282 (Feb 1973).

A system for exciting slow waves in a plasma is investigated theoretically. The possiblity of using slow waves for heating a plasma is analyzed. (auth)

31719 RADIATIVE-THERMAL WAVE IN A MOVING PLASMA. Tyurin, E.L.; Shcheglov, V.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Tech. Phys. 17: No. 8, 1269-1272 (Feb 1973).

An analytic solution is obtained for the propagation of a thermal wave caused by the absorption of monochromatic radiation in a moving plasma. The treatment is applicable for an arbitrary time dependence of the flow, in particular, for an increasing velocity due to heating of the plasma. The optimum parameters of the laser heating pulse are computed under the zero-reflection assumption. (auth)

31720 THERMAL AMPLIFICATION OF ION-ACOUSTIC WAVES. Defouw, R.J. (Harvard College Observatory, Cambridge, Massachusetts 02138). Phys. Rev. A 7: No. 2, 818-818 (Feb 1973).

The ion-acoustic instability of a uniform, current-free, two-temperature plasma requires heat conduction by electrons in addition to electron-ion energy transfer. (auth)

31721 WAVE NUMBER SPACE ANALYSIS OF PROPAGATION IN NONUNIFORM MEDIA. Brownell, J.H. (Institute for Plasma Research, Stanford University, Stanford, California, 94305). Am. J. Phys. 41: No. 2, 207-212 (Feb 1973).

It is illustrated that the propagation of disturbances in nonuniform media can often be treated in terms of a differential equation in wavenumber space. The technique is illustrated by means of the one-dimensional wave equation. (auth)

31722 EFFECT OF LOW-FREQUENCY FIELDS ON THE EXCITATION OF LOW-FREQUENCY OSCILLATIONS IN A BEAM-PLASMA DISCHARGE. Kirdyashev, K. P.; Zaykina, A. N. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 11, 1888-1892 (Nov 1972).

Translated from Radiotekh. Elektron.; 17: No. 11, 2354-2359 (Nov 1972).

The results of an experimental study of the low-frequency oscillations in a plasma, formed by an electron beam, are presented. With the excitation of low-frequency fields in a plasma, one observes a considerable rise in the intensity of the low-frequency oscillations. The most intense low-frequency oscillations are those when the frequency of the external field corresponds to the maximum of the ion-acoustic oscillation spectrum of the plasma. High-frequency oscillations are excited in the region of the plasma frequencies and cyclotron harmonics. (auth)

31723 CHARACTERISTICS OF WAVEGUIDES CONTAINING ANISOTROPIC WARM PLASMA IN THE PRESENCE OF TRANSVERSE MAGNETIC FIELD. Singh, D.; Gupta, P. N.; Tolpadi, S. K. (Banaras Hindu Univ., India). J. Inst. Telecommun. Eng.; 18: No. 7, 348-50(1972).

Starting from equations of motion and continuity equations for electrons along with Maxwell's equations, the dispersion relation is obtained for a waveguide filled with a warm, anisotropic plasma under the influence of an infinite magnetic field in a direction perpendicular to the direction of propagation. The plasma is assumed to be weakly ionized in which electrons are warm with an average temperature higher than the temperature of neutral particles, and electrons undergo ordinary hardsphere elastic type collisions with the neutral molecules. For simplicity collisions with electrons are taken care of by a constant collision frequency independent of velocity. Further, the plasma model may be considered as being a single-fluid medium in which only the electron component participates in the phenomena of interest. From the wave equation for the longitudinal component of electric and magnetic fields, it is concluded that TE modes are unaffected by the presence of collisional plasma. However, the characteristic equation for TM modes gets modified by some additional terms which are wholly dependent on collision frequency. (Indian Sci. Abstr.).

31724 ANOMALOUS PROPAGATION OF GRID-EXCITED WAVES IN A PLASMA. Ichikawa, M.; Sato, M. (Yamagata Univ., Japan). Phys. Lett.; 44A: No. 5, 335-336(2 Jul 1973).

Discontinuous phase velocity variation of the wave propagation is observed for low-frequency perturbations excited by a grid in a plasma. The abrupt change of the velocity is closely related to oscillatory damping of the wave amplitude and becomes more conspicuous with the exciting frequency. (auth)

31725 LOW-FREQUENCY FLUTE INSTABILITIES OF A BOUNDED PLASMA COLUMN. Rognlien, T.D. (Institute for Plasma Research, Stanford University, Stanford, California 94305). J. Appl. Phys. 44: No. 8, 3505-3512 (Aug 1973).

A study is made of the stability of quasineutral low-frequency ($\omega \ll \omega_{ci}$) flute waves in a low-β collisionless plasma column immersed in a uniform axial magnetic field. The column has a Gaussian number density profile and a dc radial electric field. The differential equation which describes the waves is solved both analytically and numerically for the eigenfrequencies and eigenfunctions. For the case of uniform rotation of the column, analytical solutions are obtained to determine the properties of a column bounded by a conducting cylinder. The instability is a centrifugal flute wave for this case. The boundary can be stabilizing or destabilizing for the $m = 1$ azimuthal mode, depending on its location, while for all other modes, the boundary is stabilizing. For a nonuniformly rotating column, the effects of gradual shear and abrupt shear are considered using numerical solutions. By following the evolution of these modes as the profiles are changed continuously, a unified picture of their behavior is developed. Again the behavior of the $m = 1$ mode is found to be different from that of the higher-order modes, as illustrated by the $m = 2$ mode. The $m = 1$ mode is quite sensitive to the rotation of the column near the boundary, while the $m = 2$ mode depends more on an average over the column. Also, for abrupt shear, the $m = 2$ mode evolves into a Kelvin-Helmholtz instability, while the $m = 1$ mode does not. (auth)

31726 INSTABILITY OF ELECTROMAGNETIC SURFACE WAVES SUPPORTED BY A BOUNDED PLASMA STREAM. Seshadri, S.R. (Department of Electrical Engineering, The University of Wisconsin, Madison, Wisconsin 53706). J. Appl. Phys. 44: No. 8, 3543-3549 (Aug 1973).

The characteristics of electromagnetic surface waves supported by a plane interface separating a semi-infinite region of free space from another semi-infinite region consisting of a plasma streaming parallel to the interface are investigated for the case in which the wave is progressing either in or opposite to the direction of the stream. The behavior of the surface wave is drastically different from the case in which the plasma is stationary. The surface wave has backward-wave regions. For a certain range of frequencies below the plasma frequency, the surface wave undergoes traveling wave amplification in the direction

of the stream. When its wave number is in a certain range, the surface wave progressing in a direction opposite to that of the stream is convectively unstable. The characteristics of this surface wave instability are analyzed. (auth)

31727 ION-ACOUSTIC WAVES IN A BOUNDED PLASMA. Tang, B.S.; Roberts, J.A. (Department of Physics, North Texas State University, Denton, Texas 76203). J. Appl. Phys. 44: No. 8, 3796-3797 (Aug 1973).

A systematic study was made of some of the oscillatory phenomena which are found to occur in bounded dc discharge plasmas. The nature of the oscillator patterns was explored over a pressure interval ($0.01 \leq P \leq 1.5$ Torr), a current interval ($0.5 \leq I \leq$ 10 mA), and a discharge-voltage interval ($0.8 \leq V$-(less-than-or-equal)$= 3.5$ kV) in order to establish the conditions for onset of oscillatory modes within the plasma. An rf pickup coil, to detect the oscillations, was placed such that it contained the plasma filament coaxially. Signals having a frequency range of 20-200 kHz were observed to be coming from the plasma. These frequencies were found to be sensitive to pressure, current, and discharge voltages for a given geometry tube. The gases considered in this investigation were N_2, O_2, CO_2, air (atmospheric), H_2, D_2, He, and argon. Electron densities calculated from the "resonant" conditions for the ions are presented. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 30657, 30658, 31375, 31432, and 31542.

31728 (CONF-730301-P2, pp 1187-1197) RADIOISOTOPES IN BIOLOGY AND MEDICINE. Adelstein, S. J. (Harvard Medical School, Boston). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

From the experience gathered over the past few years in the clinical use of radioisotopes for the localization of disease certain utility criteria have emerged. These include ready availability, photon energy matched to the sensitivity and resolution of the prevailing instrumentation, and appropriate half-life. For studies of regional physiology physical properties rather than chemical ones appear to be critical. (auth)

31729 (LA-5392-MS) SUMMARY OF RADIATION TRANSPORT AND RADIATION HYDRODYNAMICS. Wienke, B. R. (Los Alamos Scientific Lab., N. Mex.). Sep 1973. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

The principles of radiative dynamics are summarized and associated physical considerations and approximations are discussed briefly. The classical equations are presented, relativistic effects added, and some conventional assumptions and schemes treated. (auth)

31730 (ORAU-120) EFFECTIVE ABSORBED ENERGIES. Barber, L. R.; Cloutier, R. J.; Watson, E. E. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.). Jul 1973. 20p. Dep. NTIS $4.00.

The "effective absorbed energies" for 14 radionuclides commonly used in nuclear medicine are given. The nuclides are: carbon-11, fluorine-18, iron-59, cobalt-57, cobalt-60, gallium-67, selenium-75, strontium-85, technetium-99m, indium-111, iodine-125, iodine-131, xenon-133, and ytterbium-169. (MHR)

31731 (TID-26430) ENERGY DEPOSITION STUDIES. Annual Report, September 1, 1972–May 15, 1973. Vroom, D. A. (Intelcom Rad Tech, San Diego, Calif. (USA)). 20 May 1973. Contract AT(04-3)-167. 15p. Dep. NTIS $3.00.

Results are given from a systematic study of the energy spectrum of secondary electrons ejected from some simple hydrocarbons: hydrogen, ethane, and methane by 1.0-, 2.5-, 5.0-, 7.5-, and 10-keV electrons. Kinetic energy studies were conducted on the same molecules. (MHR)

31732 LINEAR POLARIZATION OF LOW-ENERGY-ELECTRON BREMSSTRAHLUNG. Kuckuck, R.W.; Ebert, P.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. A 7: No. 2, 456-462 (Feb 1973).

The linear polarization of bremsstrahlung from thin targets (~ 50 $\mu g/cm^2$) of Al, Cu, Ag, and Au was measured for incident electron energies of 50, 75, and 100 keV. The polarization was measured as a function of photon energy at four emission angles (θ = 22.5°, 45°, 90°, and 135°). Data presented were obtained with a Compton polarimeter having a large asymmetry ratio (from 35 to 150) and high resolution. The results have been found to be in general agreement with the predictions of various bremsstrahlung calculations. (auth)

31733 METHOD OF MEASURING γ OR X-RAY ATTENUATION DUE TO OVERLYING TISSUES IN RADIOTHERAPY. Rice, F. G.; Cowper, D. R. (Atomic Energy of Canada Ltd., Ottawa, Ont.). Brit. J. Radiol.; 46: No. 549, 715-718(Sep 1973).

A method is described for the measurement of the transmission of monoenergetic γ rays between any point on the surface of a phantom and any point inside. It utilizes the Compton-scattered radiation generated by narrow beams of primary radiation which are directed at the phantom. Radiation scattered at 90 deg. to the incident beam from a small internal volume is measured for two opposing directions of the incident beam, i.e. 0 deg. and 180 deg. The ratio of these two measurements is a measure of the relative transmission between the scattering volume and each of the two opposite surfaces. Multiplication of this ratio, or its inverse by the measured total transmission along the beam path gives the square of the partial transmission from one surface to the internal volume. The method has been verified experimentally to an accuracy of ±3% and is expected to be useful in radiotherapy for measuring transmission through tissue inhomogeneities to help establish tumor dose more accurately. Equipment and technique for possible clinical application is discussed briefly. (auth)

31734 RANGE-ENERGY RELATION FOR 0.1 TO 600 keV ELECTRONS. Gledhill, J. A. (Science Research Council, Slough, Eng.). J. Phys., A (London); 6: No. 9, 1420-1428(Sep 1973).

Available data on the range of electrons with energies less than 600 keV in air and other light materials are reviewed critically. It is shown that the practical (extrapolated) range R_p (in g cm^{-2}) can be related to the energy E (in keV) by using the following expressions: $x = \lg E$; $y = \lg R_p$; $y = -6.160 + 2.585x - 0.220x^2$; (E > 100 keV); $y = 5.100 + 1.358x + 0.215x^2 - 0.043x^3$; (0.1 < E < 100 keV). The need for further work at energies less than 10 keV is stressed. (auth)

31735 PERCENTAGE DEPTH DOSE FOR HIGH ENERGY X-RAY BEAMS IN RADIOTHERAPY. Rawlinson, J. A.; Johns, H. E. (Ontario Cancer Inst., Toronto). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 919-922(Aug 1973).

It is pointed out that certain high energy x-ray machines for radiotherapy have depth dose characteristics which are less than optimum due to improper design and due to the fact that certain basic principles enunciated years ago by the Betatron groups at the University of Illinois and the University of Saskatchewan have been either ignored or forgotten. This is an attempt to alert purchasers and manufacturers of high energy machines to this problem. (MHR)

31736 WHOLE-BODY COUNTER EFFICIENCY CALCULATIONS FOR DISTRIBUTED SOURCES IN A HUMAN PHANTOM. Andrasi, A.; Koetel, G. (Central Research Inst. for Physics, Budapest). pp 469-476 of Health Physics Problems of Internal Contamination. Bujdoso, E. (ed.). Budapest; Akademiai Kiado (1973).

From 2nd European congress on radiation protection; Budapest, Hungary (3 May 1972). See CONF-720503-.

The space and energy dependence of the full energy peak efficiency of the 6" × 4" NaI(Tl) detector of a whole-body counter was calculated by computer from input data measured on point sources. By volume integration of this empirical function, the efficiency of the counter was evaluated for a BOMAB-type human phantom. Calculations were carried out for uniformly distributed sources with gamma energies of 0.1–2.0 MeV, in chair, arc, and scanning geometries. The calculations were extended to cases of activity confined in geometrically well-defined organs within the phantom. Measurements performed to verify the calculated values showed a better than ±4% agreement. (auth)

31737 EXPERIMENTAL ANALYSIS OF PENETRATION MECHANISM OF HIGH POWER DENSITY ELECTRON BEAM INTO METAL. Miyazaki, T.; Taniguchi, N. (Inst. of Physical and Chemical Research, Wako, Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 67: No. 1, 7-17(Mar 1973).

Deep penetration mechanism of high power density electron beam is discussed experimentally. X-rays generated as a consequence of bombardments of stationary and moving electron beams on a metal target are measured. From the fact that the x-rays generated fluctuate and taking the balance of forces into consideration, a model for the penetration path of the electron beam is proposed. This model represents a linear cavity configuration. The cavities are unstable to collapse and reformed as a result of thermal fluctuation. The movement of fusion zone is also discussed. The collapse and reformation of the cavities and the movement of the fusion zone are related to difference in the shape of the fusion zone for different metals. (auth)

31738 BEAM DIAMETER AND SCAN VELOCITY EFFECTS ON LINEAR BONE MASS MEASUREMENT BY PHOTON ATTENUATION. Watt, D. E. (Dundee Univ., Eng.). Phys. Med. Biol.; 18: No. 5, 673-685(Sep 1973).

A theoretical analysis is presented of the fundamentals involved in the calculation of the linear bone mass from the observed transmitted photon intensities. Intermittent scanning and continuous scanning methods are considered. The absolute errors caused by finite beam diameters and velocity of scan are calculated. It is demonstrated that only partial correction is possible for errors associated with the beam diameter, whereas those associated with scan velocity can be fully compensated. Although most systems applied to routine measurements of linear bone mass are independently calibrated and are claimed to have correlation coefficients of around 0.96 it is found that conditions exist where the error between two individual measurements, despite calibration, may be greater than 20%. (auth)

31739 CALCULATION OF X-RAY SPECTRA IN THE DIAGNOSTIC ENERGY RANGE, DUE REGARD BEING PAID TO

SCATTERED RADIATION. Reiss, K. H.; Steinle, B. (Siemens, AG, Erlangen, Ger.). Phys. Med. Biol.; 18: No. 5, 746-747 (Sep 1973).

Using Monte Carlo methods and a range of water phantoms 0 to 30 cms thick the spectra and mean number of scattered events for both penetrating and backscattered quanta were calculated in the following cases. (a) Monoenergetic, narrow beam radiation for quantum energy of 25, 50, 75 and 100 keV. (b) Monoenergetic radiation as before, but for a broad beam of maximum diameter 30 cm. (c) continuous, experimentally determined x-ray spectra for broad beams up to 30 cm dia., tube voltage 40 to 130 keV. Complete results are available on request, but the following are presented in a brief note: (1) spectrum of the scattered radiation at 30° to the direction of the primary beam, phantom thickness 20 cm H_2O, tube voltage 100 KVp. (2) Ratio of total radiation with respect to the primary intensity and ratio of scatter with respect to the total radiation. (UK)

31740 SPUTTERING AND BACKSCATTERING OF keV LIGHT IONS BOMBARDING RANDOM TARGETS. Weissmann, R.; Sigmund, P. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Radiat. Eff.; 19: No. 1, 7-14(May 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Range and damage distributions have been calculated for light ions slowing down in heavy targets in the energy region where electronic stopping is dominating and approximately proportional to velocity. Following Schiøtt's (Kgl. Danski Videnskab Selskab, Mat.-Fys. Medd.; 35: No. 9 (1966)) approach, well-known integral equations for spatial moments were approximated by different equations, and the latter solved by numerical integration. Moments over the two distributions up to third order have been obtained, and the distributions were constructed by use of the Edgeworth expansion. From the profiles, backscattering coefficients and relative sputtering yields were determined. Comparison is made with previous theoretical results, computer simulation and experimental results. An improved calculation of the sputtering yield of light ions bombarding a thin film is also presented. (auth)

31741 FAST NEUTRON DOSE RATE AS A FUNCTION OF INCIDENT DEUTERON ENERGY FOR D + ^{9}Be. August, L. S. (Naval Research Lab., Washington, DC); Theus, R. B.; Attix, F. H.; Bondelid, R. O.; Shapiro, P.; Surratt, R. E.; Rogers, C. C. Phys. Med. Biol.; 18: No. 5, 641-647(Sep 1973).

The apparatus and techniques employed in measuring the thick target, fast neutron dose rate as a function of incident deuteron energy for D + ^{9}Be over the energy range $15 \leq E_D \leq 40$ MeV are discussed. The resulting data are compared with a summary of previous measurements made at other laboratories. There are significant discrepancies between the two sets of data at the higher energies. (auth)

31742 RADIATION OF A CHARGED PARTICLE MOVING IN A RADIALLY INHOMOGENEOUS MEDIUM. Barukov, K. A.; Kadantsev, V. N. (Moscow Pedagogical Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 9, 1544-1546(Mar 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 9, 1927-1930(Sep 1972).

The radiation of a charged particle moving along the axis of a cylindrically inhomogeneous medium is investigated by the method of geometric optics. Expressions for the field of the moving particle and the radiation spectrum are obtained and the Cherenkov losses are found. The possibility of generating a waveguide mode in an inhomogeneous medium is investigated. (auth)

31743 CONTRIBUTION TO THE CALCULATION OF THE RADIATION EXPOSURE INTENSITY DUE TO COMPTON SCATTERING. Fernandez-Rubio, F. (Nuclear Iberica, S. A., Madrid). Energ. Nucl. (Madrid); 17: No. 82, 123-131(1973). (In Spanish).

As an introduction the well-known expression $D_x = (D_0 S/X^2)A_\phi$ is derived. This expression permits the calculation of the exposure D_x produced at a point in space by γ radiation scattered by an object of surface S irradiated by a γ source which produces on this surface an exposure intensity D_0 and which is placed at a distance X from the point in space. An original expression for the "radiation albedo" A_ϕ is obtained as the basic objective. This is applied to the most general case of a scatterer composed of various coatings and different thickness. (tr-auth)

31744 HEAT DEFECT OF LOW ENERGY X-RAYS ABSORBED IN CARBON AND VARIOUS PLASTICS. Saebal, M.; Schmidt, T.; Pauly, H. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Health Phys.; 25: No. 5, 519-521(Nov 1973).

The heat effect of low energy x-rays on polyethylene, polystyrene, polyamide, polymethylmethacrylate, polyvinylchloride and carbon has been measured using a twin calorimeter. It was found that the heat defect in tissue-equivalent materials and other plastics usually amounts to a few per cent of the energy imparted to the material; in some cases a considerable additional release of heat - due to radiation-induced reactions with dissolved oxygen - can occur. It is emphasized that the value of the heat defect must be checked and its possible dependence on accumulated dose taken into account before a calorimeter made out of plastic material is used for accurate radiation dosimetry. (UK)

31745 ALPHA-PARTICLE STOPPING CROSS SECTION OF SILICON AND GERMANIUM. Lin, W.K.; Olson, H.G.; Powers, D. (Baylor University, Waco, Texas 76703). J. Appl. Phys. 44: No. 8, 3631-3634 (Aug 1973).

Stopping cross sections of α particles for silicon and germanium have been measured for $0.3 \leq E_\alpha \leq 2.0$ MeV. The experimental method consists of the elastic scattering of α particles either from a thick Ta backing onto which the stopping element has been evaporated, or directly from the film of stopping element evaporated onto a thick Al backing. The results were analyzed using a three-parameter formula for stopping cross section recently suggested by Brice. With the parameters obtained from a least-squares fit, the formula was found to be useful in calculating the stopping cross sections for energies outside the measurements, at least up to 10 MeV. (auth)

Radiation Protection Standards

31746 SI UNITS IN RADIOLOGY AND RADIATION DETECTION. Liden, K. (Lund Univ., Sweden); Wyckoff, H. O.; Allisy, A. Fortschr. Geb. Roentgenstr. Nuklearmed.; 119: No. 2, 242-244 (1973). (In German).

The difficulties and problems are discussed which arise in medical radiation protection by the conversion of the ICRU units activity (Ci) absorbed dose (rad), absorbed dose rate (rad $\times$ s^{-1}), exposure dose (R) and exposure dose rate (R $\times$ s^{-1}) into the SI units. (GE)

31747 SI UNITS IN RADIATION MEASUREMENT. Jennings, W. A. (National Physical Lab., Teddington, Eng.). Phys. Med. Biol.; 18: No. 5, 732-737(Sep 1973).

The conclusions of the SI working party report submitted to the BCRU are briefly considered with reference to the process of change. It is suggested that the SI unit of absorbed dose, 1 J kg^{-1}, be adopted gradually and a special name be adopted. The SI unit J kg^{-1}s^{-1} of absorbed dose rate should also be adopted. It is recommended that the quantity exposure be progressively abandoned, but where retained, the SI unit C kg^{-1} be adopted gradually (A special name was not thought necessary). Where exposure rate is retained, the SI unit C kg^{-1}s^{-1} or A kg^{-1} should be used. It is pointed out that a long period of change may be needed, in relation to activity, with reviews of progress. A special name for "nuclear transformation per second" is needed, together for names and symbols of the prefixes meaning 10^{15} and 10^{18}. The retention of the rem is recommended to avoid confusion between absorbed dose and a dose equivalent. It is pointed out that a special unit for dose equivalent is required for legal documents in many countries. (UK).

31748 GOVERNMENTAL PRIMARY STANDARD OF THE UNIT OF POWER OF ABSORBED DOSE OF PHOTON IONIZING RADIATION. Bregadze, Yu. I.; Isaev, B. M.; Tultaev, A. V.; Sil'chenko, A. P.; Korshikov, A. V. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 3, 313-319(Mar 1973).

Translated from Izmer. Tekh.; 16: No. 3, 3-7(Mar 1973).

In the governmental primary standard the unit of power of absorbed dose of photon ionizing radiation is reproduced for energy of γ radiation equal to 0.2 pJ (1.25 MeV). The size of the unit of power of absorbed dose for other energies of photon radiation is transmitted to measuring instruments also with the aid of working standards. The governmental primary standard consists of a complex of the following measurement means: (1) radiation equipment generating collimated cobalt-60 γ radiation; (2) "phantom-calorimeter" measuring equipment consisting of a graphite phantom having a calorimeter mounted in it, and a set of apparatus for precision measurement of the power of absorbed γ radiation in graphite; (3) checking stand and graphite phantom having an opening for placement of a probe ionizing chamber into that point of the phantom where the power of absorbed radiation dose measured by the calorimeter is reproduced. In addition, the composition of the standard includes auxiliary equipment: a calibrated ruler for setting the apparatus detectors at a certain distance from the radiation source; platform with carriage for shifting the apparatus in the radiation beam; and a control panel. (MHR)

31749 MEMORANDUM ON ICRU REPORT 19, RADIATION QUANTITIES AND UNITS. Jennings, W. A. (National Physical Lab., Teddington, Eng.). Phys. Med. Biol.; 18: No. 5, 730-732 (Sep 1973).

Brief comments are made by the British Committee on Radiation Units and Measurements (BCRU) concerning ICRU Report 19 (1971). Recommendations are made that Part I of the report be adopted for use in the U. K. Part I is concerned with fundamental quantities and units, including definitions of specific energy absorbed dose D and lineal energy, the revision of the definitions of activity, and the replacement of specific gamma ray constant with exposure rate constant. The continued use of special units rad, roentgen, curie and rem is advocated, subject to further discussion with relation to the SI system. The BCRU felt the need for more discussion on the recommendations in Part II, concerning quantities and units used in radiation protection. Reference is made to dose equivalent and the lack of precise definition of quality factor. Specification of ambient radiation levels are mentioned with reference to the absorbed dose index and dose equivalent index. (UK)

31750 MANUAL OF GOOD SAFETY PRACTICES FOR INDUSTRIAL GAMMA RADIOGRAPHY. Washington, DC; National Bureau of Standards (1973). 18p. (ANSI-N536).

Safety procedures are presented for the guidance of personnel using radioisotope γ sources for industrial radiography. It is pointed out that the radiation sources are of a strength to constitute a definite health hazard, yet are often used under adverse circumstances where the environment and work load pressures are frequently hostile to even rudimentary safety procedures. Instrument design characteristics that insure the shielding of the source when not in use are reviewed, and inspection and maintenance procedures are outlined. (CH)

Radiation Source Calibration and Standardization

31751 GOVERNMENTAL PRIMARY STANDARD FOR THE UNIT OF ACTIVITY OF NUCLIDES. Karavaev, F. M.; Konstantinov, A. A.; Kochin, A. E.; Khol'nova, E. A.; Alekseev, V. Ya.; Drichko, A. F.; Kul'kova, L. P. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 1, 5-12 (Jan 1973).

Translated from Izmer. Tekh.; 16: No. 1, 6-11 (Jan 1973).

A complex of standard equipment created for reproducing the unit of nuclide activity is described at length. The approved standard provides reproduction of the unit of activity of any radionuclides having a half-decay period greater than 10^3 sec over a wide range of values of 10^{-1} to 3×10^{12} decays/sec and the transmission of the size of the unit by means of a hard radiation source and by means of radioactive solutions, i.e., by a basic mass of radioactive specimens, and also by means of standard and primary radiometric equipment. (MHR)

31752 FILM CALIBRATION OF STRONTIUM-90 OPHTHALMIC APPLICATOR. Kahlig, C. A.; Smith, A. R.; Almond, P. R. (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 909-912 (Aug 1973).

A simple method using the dose-density relationship of film is described which can be used to obtain the surface dose rate and mid-line depth dose from a ^{90}Sr ophthalmic applicator employed in radiotherapy for lesions of the eye. It is shown that a method based on equations developed by Chhabra gives the same results for the surface dose rate. In order to obtain the surface dose to tissue from the dose to lucite one must multiply the dose to lucite by the ratio of the mass stopping powers of water and lucite. S_{water} (2.27 MeV)/S_{lucite} (2.27 MeV) = 1.05. The eye tissue is assumed to be equivalent to water. (auth)

Shielding Calculations and Experiments

31753 QUALITY CONTROL: SPOT CHECK TO UNCOVER COLLIMATOR LEAKAGE. Lamoureux, J. (Hospital Notre-Dame Montreal). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 118: No. 4, 913-915 (Aug 1973).

Collimators supplied with the gamma cameras are so designed that assemblage failure may be present and give rise to detection of artificial and unwanted patterns of radiation. The typical pattern obtained with a faulty 4,000 hole collimator is shown. The techniques used to demonstrate the cause are presented. It is suggested that gamma camera users run a check of their collimators to verify the quality of their assemblage. (auth)

31754 PRINCIPLES OF NEUTRON SHIELDING CALCULATIONS. Panelle, G. (Controle-Radioprotection, Mol, Belgium). J. Belge Radiol.; 56: No. 2, 167-174 (1973). (In French).

Attention is drawn to the difficulty of calculating neutron shields, which results in particular from the complexity of the phenomena of the interactions of neutrons with matter. The possible interactions are classified either as slowing-down interactions or as absorbing interactions; this leads to the description of the phenomena of elastic diffusion and of inelastic diffusion. The interest in hydrogen as a slowing-down material, and the risk of emission of parasitic gamma rays during the interaction processes is derived from that description. Some practical data and a schematic example of the application of the theoretical considerations are included. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 31155, 31627, 31721, 32155, 32159, and 32194.

31755 (CONF-730301-P2, pp 1023-1024) MODEL INDEPENDENT DATA ANALYSIS. Cook, B. C. (Iowa State Univ. of Sci. and Tech., Ames). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The direct experiment transformation method for data analysis is briefly described. (WDM)

31756 SELF-ADJOINT FORM OF THE LINEAR TRANSPORT EQUATION. Silvennoinen, P. (Technical Research Centre of Finland, Otamiemi). J. Math. Anal. Appl.; 43: No. 2, 529-536 (Aug 1973).

The general energy-dependent case with a nonsymmetric integral kernel that additionally contributes to the nonself-adjoint nature of the problem is considered. Sufficient conditions are derived that ensure the existence of the self-adjoint transport operator analogous to one constructed previously for the one-speed case. Standard variational approximation techniques are used. (JFP)

31757 FINITE ELEMENT PROGRAM PACKAGE FOR AXISYMMETRIC SCALAR FIELD PROBLEMS. Konrad, A.; Silvester, P. (McGill Univ., Montreal). Comput. Phys. Commun.; 5: No. 6, 437-455(Jun 1973).

The program written in FORTRAN IV G for IBM 360/75 solves Laplace, Poisson, or Helmholtz equations subject to Dirichlet or homogeneous Neumann boundary conditions by the higher-order polynomial triangular finite-element method. (CES)

31758 PRODUCT-VECTOR BASIS AND OCCUPATION-NUMBER BASIS IN FOCK SPACE FOR BOSONS AND FERMIONS. Leaf, B. (State University of New York, College at Cortland, Cortland, New York 13045). J. Math. Phys. (N.Y.) 14: No. 7, 988-994 (July 1973).

A basis of products of one-particle vectors (symmetric or antisymmetric for bosons or fermions) is defined, and related to the occupation-number basis in an abstract Fock space, a generalization of the wave-mechanical configuration representation of the space of second quantization. Creation and destruction operators are simply defined in the product-vector basis and shown to have their usual properties in occupation-number representation. Algebraic properties of product vectors are developed and illustrated. The representation of operators in the product-vector basis is described, together with a brief discussion of the effects on these operators of transformations from one set of one-particle vectors to another. A simple treatment of density and reduced density operators for systems of bosons or fermions is given in the product-vector basis. The relationship between degeneracy in the Fock-space spectrum of an additive operator NA_1 and degeneracy in the spectrum of one-particle operator A_1 is obtained. (auth)

31759 A NEW BASIS FOR THE REPRESENTATIONS OF THE ROTATION GROUP. LAMÉ AND HEUN POLYNOMIALS. Patera, J.; Winternitz, P. (Centre de Recherches Mathématiques, Université de Montréal, Montréal 101, P.Q., Canada.). J. Math. Phys. (N.Y.) 14: No. 8, 1130-1139 (Aug 1973).

The representation of the rotation group O(3) is developed in a new basis, consisting of eigenfunctions of the operator $E=-4(L_1^2+rL_2^2)$, where $0<r<1$ and L_i are generators. This basis $|J\lambda>$ is shown to be a unique nonequivalent alternative to the canonical basis (eigenfunctions of L_3). The functions $|J\lambda>$ are constructed as linear combinations of canonical basis functions, and are shown to fall into four symmetry classes, distinguished by their behavior under reflections of the individual space axes. Algebraic equations for the eigenvalues λ of E are derived. When realized in terms of functions on an O(3) sphere, the basis $|J\lambda\rangle$ consists of products of two Lame polynomials, obtained by separating variables in the corresponding Laplace equation in elliptic coordinates. When realized in a space of functions of one complex variable, $|J\lambda\rangle$ are Heun polynomials. Applications of the new basis in elementary particle, nuclear, and molecular physics are pointed out, due in particular to the symmetric form of $|J\lambda\rangle$ as functions on a sphere and to the fact that they are the wave functions of an asymmetrical top. (auth)

31760 RADIATION OF SPINLESS ELECTRONS IN A HOMOGENEOUS MAGNETIC FIELD. Yildiz, A. (College of Technology, Kingsbury Hall, University of New Hampshire, Durham, New Hampshire 03824). Phys. Rev. D 8: No. 2, 429-433 (15 July 1973).

The radiation of a spinless charged particle in an external homogeneous magnetic field is described by the methodology of source theory. The gauge-invariant, proper-time Green's function of the particle is used in the analysis with a noncausal photon propagation function. Results are in agreement with a new method proposed by Schwinger and also with his earlier work on the classical radiation of accelerated electrons. (auth)

31761 PROPERTIES OF MATRIX REPRESENTATIONS OF SU(3). McDonald, A.; Rosen, S.P. (Purdue University, Lafayette, Indiana 47907). J. Math. Phys. (N.Y.) 14: No. 8, 1006-1016 (Aug 1973).

Matrices representing the Lie algebra of SU(3) can also serve as Clebsch-Gordan coefficients for the direct product of the basis states of the representation times their adjoints. This fact enables us to obtain a number of properties, both general and specific, of SU(3) matrices. To carry out our program we develop a general formula for constructing a symmetric tensor of rank $(n+1)$ from the product of a tensor of rank n times an octet. We then deduce some general properties concerning the multiplicity of representations contained in the direct product of a representation and its adjoint. In the specific cases of the six- and ten-dimensional representations we obtain the characteristic equation for the SU(3) matrices, and for the 27-dimensional representation we obtain other properties. We also compute the traces of products of two, three, and four matrices in any representation. (auth)

31762 WILSON'S THEORY OF CRITICAL PHENOMENA AND CALLAN-SYMANZIK EQUATIONS IN $4-\epsilon$ DIMENSIONS. Brezin, E.; Le Guillou, J.C.; Zinn-Justin, J. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, BP. No. 2-91 Gif-sur-Yvette, France). Phys. Rev. D 8: No. 2, 434-440 (15 July 1973).

The relevance of the Gell-Mann-Low eigenvalue condition to the description of the critical behavior in statistical mechanics is discussed in detail, using the natural framework of the Callan-Symanzik equations, in $4-\epsilon$ dimensions. Wilson's method relying on the existence of a bare coupling constant adjusted to yield scaling laws in perturbation theory is justified and Wilson's results for critical exponents are rederived using renormalized perturbation theory. (auth)

31763 TAUTOLOGIES AND OPTIMIZATION OF N/D EQUATIONS. Ciulli, S.; Pomponiu, C.; Sabba-Stefanescu, I.; Steinbrecher, G. (Institute for Atomic Physics, Bucharest, Romania). Phys. Rev. D 8: No. 2, 455-467 (15 July 1973).

It is usually accepted that the solutions of the N/D equations are seriously affected by the uncertainties of the input data as well as by the lack of information about short-range forces (distant regions of the left-hand cut of the scattering amplitude). However, so far little attention seems to have been paid to a systematic investigation of the mathematical ways in which the influence of this lack of knowledge could be minimized. To this end, it appeared desirable to also include as input data the real part of the amplitude which can be found in essentially the same way as the imaginary part by analytic continuation from the crossed reactions. Then, the basic idea is to exploit the fact that different theoretical methods which are logically equivalent and yield exactly the same results for the same set of "correct" data (we call these methods "tautological"), nevertheless could behave in totally different ways when faced with "wrong" (error-affected) data. "Correct" in our case would mean left-hand-cut limiting values absolutely consistent both with analyticity and unitarity. Hence, the problem that arises is first to find all the possible tautological integral kernels and then to choose among them that one which is most insensitive to the lack of knowledge concerning the input data. Such a kernel is shown to be obtained by replacing one of the Cauchy kernels in the integral equations by a Poisson kernel weighted with a function determined by the errors. Optimal methods of construction, not based on integral equations, are also presented. (auth)

Quantum Field Theories

Refer also to abstracts 31182, 31229, and 31610.

31764 FIELD-THEORETIC METHODS IN THE CRITICAL REGION OF A PHASE TRANSITION. Brout, R. (Univ. Libre, Brussels). Nuovo Cim.; 17A: No. 3, 417-433(1 Oct 1973).

It is shown that the Migdal-Polyakov bootstrap is valid when $T \simeq T_c$ and invalid when $T \neq T_c$. The solution of the conformal bootstrap at $T = T_c$ is sketched in terms of the ϵ-expansion. Arguments of Wilson and of Migdal for strong length scaling when $T \neq T_c$ are questioned and that of Domb against scaling reviewed. A

new argument against length scaling, based on the thermodynamic behavior of the zero-momentum vacuum polarization loop, is presented. It is shown that the difficulties of length scaling can be surmounted by introducing a new length scale for small momenta: $\mu' \sim t^{\nu'}$ for $q \ll \mu$, where $\nu' > \nu$ (μ is a mass and $t = (T - T_c)/T_c$; $\mu = \xi^{-1} = t^{\nu}$ is the inverse correlation distance). Finally an argument for $\delta = 5$ in consequence of the fixed point at $t = 0$ is presented. (auth)

31765 EXTRA GOLDSTONES IN GAUGE THEORY WITH SPONTANEOUS BREAKING. Tyutin, I. V.; Fradkin, E. S. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 18: No. 1, 221-232 (Jul 1973). (In Russian).

The theory of neutral gauge fields with spontaneous symmetry breaking is used as an example to consider the physical nature of Goldstone fields in the case when there are "extra" Goldstone fields in the absence of the gauge interaction. "Extra" means that the number of Goldstone fields exceeds the number of spontaneously broken gauge transformations. It is shown that in the presence of gauge interaction the "extra" goldstones stay physical (and have zero or a very small mass). (auth)

31766 FIELD RENORMALIZATION AND REDUCTION FORMULA IN QUANTUM ELECTRODYNAMICS. Zwanziger, D. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. Lett. 30: No. 19, 934-937 (7 May 1973).

An Ansatz is proposed for the asymptotic field of a charged particle which gives the known power-law behavior $(p^2-m^2+i\epsilon)^{-1-\beta}$, $\beta \neq 0$, for the electron propagator near the mass shell. This allows the electron-wave-function renormalization to be related to the normalization of the asymptotic field. A reduction formula is presented, expressing the S matrix in terms of Green's functions which are evaluated according to a precise on-mass-shell renormalization prescription. (auth)

31767 GRIFFITHS-HURST-SHERMAN INEQUALITIES AND A LEE-YANG THEROREM FOR THE $(\phi^4)_2$ FIELD THEORY. Simon, B. (Centre de Physique Théorique, Centre National de Recherche Scientifique, Marseille, France); Griffiths, R.B. Phys. Rev. Lett. 30: No. 19, 931-933 (7 May 1973).

The Griffiths-Hurst-Sherman inequalities and the Lee-Yang zero theorem in the theory of Ising ferromagnets are shown to hold in a two-dimensional self-coupled Bose quantum field theory with interaction $:a\phi^4 + b\phi^2 - \mu\phi:$. Applications include the continuity of the infinite-volume "magnetization," $\langle\phi(0)\rangle$, away from $\mu = 0$. Our results should carry over to three or four dimensions once it is known how to control the ultraviolet divergences in these theories. (auth)

31768 ASYMPTOTIC BEHAVIOR OF TRAJECTORY FUNCTIONS AND SIZE OF CLASSICAL ORBITS. Chang, S.; Rosner, J.L. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 8: No. 2, 450-454 (15 July 1973).

The strong-coupling limits of several ladder-graph models are explored. A correlation is found between the power of the coupling constant appearing in the leading Regge trajectory α ($t = 0$) and the size of classical orbits described by the coordinate-space Bethe-Salpeter wave function. Specifically: (i) For the ϕ^3 theory with exchanged mass $m \neq 0$, the orbit radius r_0 approaches a fixed value, and α ($t = 0$) $\sim g^{(1/2)}$. (ii) For ϕ^3 with $m = 0$, r_0 grows linearly with g and α ($t = 0$) $\sim g$. (iii) For ϕ^4, $r_0 \to 0$ and the leading singularity is a fixed cut in t. Expansions about classical orbits are possible in the first two cases, and lead in lowest order to a harmonic-oscillator equation from which corrections to the classical result may be derived. (auth)

31769 NULL-PLANE FIELD ALGEBRA. Bányai, L.; Mezincescu, L. (Institute of Physics, Bd. Păcii 222, Bucharest, Romania). Phys. Rev. D 8: No. 2, 417-423 (15 July 1973).

Field-algebra current commutators on the null plane are deduced using Dirac's canonical quantization method. The corresponding scaling relations are $F_2(\omega) = -2\omega F_1(\omega)$, $F_3(\omega) = 0$. (auth)

31770 A NOTE ON KATO'S PERTURBATION THEORY. Schroeck, F.E. Jr. (Department of Mathematics, Florida Atlantic University, Boca Raton, Florida 33432). J. Math. Phys. (N.Y.) 14: No. 7, 829-830 (July 1973).

The results of T. Kato are expanded by generalizing the relative bound condition on the perturbation to determine the domain of powers of the perturbed operator and by exhibiting some useful relative bounds between the unperturbed operator, the perturbed operator, and the perturbation. (auth)

31771 VACUUM-POLARIZATION POTENTIAL, FINITE-SIZE EFFECTS, AND THE COULOMB PROPAGATOR. Owen, D.A. (University of Surrey, Department of Physics, Guildford, Surrey, United Kingdom). Phys. Rev. D 8: No. 2, 424-429 (15 July 1973).

A momentum representation for the fermion propagator in an external electromagnetic field is derived from which a convenient form for the vacuum-polarization potential is obtained. This expression, for which the trace has already been taken, can be used for calculating the dependence of higher-order corrections on the form factors of the external field. Expanding in powers of the external field we obtain the lowest-order correction as well as the third-order correction to the vacuum-polarization potential. The external-field, fermion propagator is also used to obtain an expression for the Delbrück scattering amplitude. (auth)

31772 QUANTIZATION OF A STRING OF SPINNING MATERIAL—HAMILTONIAN AND LAGRANGIAN FORMULATIONS. Iwasaki, Y.; Kikkawa, K. (Department of Physics, The City College of the City University of New York, New York, New York 10031). Phys. Rev. D 8: No. 2, 440-449 (15 July 1973).

The dynamics of a relativistic string made of spinning material is discussed in two different formulations. The first is a manifestly covariant formulation under a gauge transformation. The second is a Hamiltonian formalism which enables us to make the transition from the classical to the quantum description in a coherent way. The Lagrangian is also constructed. The results of our investigations are as follows: (1) The mass spectra here coincide with those of the Neveu-Schwarz model. (2) The model is ghost-free. (3) The Poincaré generators $M^{\mu\nu}$ and P^{μ} are constructed. The quantization is shown to be consistent with Lorentz covariance if the dimension of space-time is 10 and the Regge intercept is 1/2. (auth)

31773 CONSTRAINTS AND ANOMALIES IN FINITE QUANTUM ELECTRODYNAMICS. Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 8: No. 2, 385-397 (15 July 1973).

It is argued that the leading singularity of the electron-photon vertex is inversion-invariant in finite quantum electrodynamics. Crewther's method is then applied to this vertex to obtain a number of consistency relations among the c-number coefficients that appear in various short-distance expansions. As a result, if there is a Gell-Mann-Low eigenvalue which makes Z_3 finite, then either (1) the leading singularity of the electron-photon Green's function vanishes in the limit obtained from the short-distance behavior of the two-fermion fields, or (2) the scale-invariant short-distance expansion for the q-number part of $T\{\bar{\psi}(0)\gamma^{\mu}\psi(x)\}$ has infinite c-number coefficients. If the first possibility occurs, then either $Z_2 = 0$ or the amputated vertex vanishes in the corresponding limit. The structure of the electron-photon vertex also permits one to characterize the possible q-number anomaly for the equal-time commutator $[\psi(x), j^0(0)]\delta(x^0)$ without reference to perturbation theory. (auth)

31774 NOTE ON THE EQUIVALENCE THEOREM. Lam, Y.P.; Schroer, B. (Institut für Theoretische Physik, der Freien Universität Berlin, Berlin, Germany). Phys. Rev. D 8: No. 2, 657-659 (15 July 1973).

A simplified proof of the equivalence theorem on Lagrangian field theories is indicated. Applying the theorem to a system of free particles, we show that localizability of a Lagrangian density does not necessarily imply the localizability of the fields. (auth)

31775 COMMENT ON THE SHORT-DISTANCE BEHAVIOR OF THE AXIAL-VECTOR CURRENT. Köberle, R. (Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany); Nielsen, N.K. Phys. Rev. D 8: No. 2, 660-664 (15 July 1973).

Using the Callan-Symanzik equations as a tool to study the short-distance behavior of the gauge-invariant axial-vector current in quantum electrodynamics, we conclude that as a consequence of Ward identities the axial-vector current is required to scale noncanonically. The Wilson-Crewther calculation of the anomaly can not be carried out, although its use is legitimate in phenomenological applications treating electromagnetism to lowest order. (auth)

31776 EIKONAL ESTIMATES AND CANCELLATIONS AT HIGH ENERGIES. Blankenbecler, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Fried, H.M. Phys. Rev. D 8: No. 2, 678-681 (15 July 1973).

Using functional methods and the eikonal model, the leading s dependence of elastic scattering in a modified ϕ^3 theory is discussed. An approximate evaluation of ladder or tower graphs and certain nonplanar graphs reveals strong cancellations. The net contribution falls as a power of the energy rather than saturating the Froissart bound, as found in less complete treatments of multiperipheral models. (auth)

31777 SCALING AND CHIRAL WARD IDENTITIES AND THE AXIAL-VECTOR CURRENT ANOMALY. Shei, S. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850); Zee, A. Phys. Rev. D 8: No. 2, 597-604 (15 July 1973).

We combine chiral and "scaling" Ward identities in an analysis of the axial-vector current anomaly. This leads to a proof of the Adler-Bardeen theorem. The "scaling" Ward identities we used may be properly called "response equations"; they are slight generalizations of the Callan-Symanzik equation. Our discussion is given for a class of theories which includes the σ model and massive vector-boson theory. (auth)

31778 NONANALYTICITY IN THE CHIRAL PERTURBATION THEORY. Kang, J.S. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 8: No. 2, 669-672 (15 July 1973).

Nonanalytic behavior in chiral perturbation theory is studied in the framework of quantum field theory. It is shown that to first order of pion interactions, renormalization does not change nonanalyticity of S-matrix elements. But there is a change in such behavior for current-matrix elements. It is also noted that there are no terms of $O(\mu^2 \ln \mu^2)$ in hadronic masses, pseudoscalar-meson-baryon couplings, and meson-meson scattering amplitudes. (auth)

31779 FURTHER INVESTIGATIONS ON THE CONSISTENCY PROBLEM WITH SPIN-3/2 INTERACTIONS. Soo, W.F. (Theoretical Physics Institute, Department of Physics, University of Alberta, Edmonton, Alberta, Canada). Phys. Rev. D 8: No. 2, 667-669 (15 July 1973).

Kimel and Nath's work on quantization of the charged spin-3/2 field is extended to fourth order in the charge. The anticommutator is found to agree with that of Johnson and Sudarshan to this order. It is inferred that Kimel and Nath's quantization is also inconsistent. (auth)

Gravitation and General Relativity

31780 SPACE AND TIME IN THE MICROWORLD. Blokhintsev, D. I. Dordrecht, Netherlands; D. Reidel Publishing Company (1973). 340p. $39.50.

Translation of Prostranstvo i vremya v mikromire by Zdenka Smith.

The topics discussed cover geometrical measurements in the macroworld and in the microworld including the relativistic case, the role of finite dimensions of elementary particles, causality in quantum theory, macroscopic causality, a generalization of causal relations and geometry, and experimental questions. (JFP)

31781 GENERAL RELATIVITY AND ENERGY. Jackson, A. T. (Belfast Coll. of Tech.). Phys. Educ.; 8: No. 6, 411-414 (Sep. 1973).

When considering the general theory of relativity, or Einstein's theory of gravitation as it is sometimes called, acceleration and gravitation are intrically related and doubts are raised over Newton's law of universal gravitation. Two interesting effects of Einstein's theory are discussed. Firstly that if a beam of light approaches a large gravitational mass it undergoes a bending effect and secondly the passage of time on a large celestial body moves more slowly than on a smaller body. (UK)

31782 DYNAMICS FOR CLASSICAL RELATIVISTIC PARTICLES: CIRCULAR ORBIT SOLUTIONS AND THE NONRELATIVISTIC LIMIT. Cordero, P. (International Centre for Theoretical Physics, Trieste, Italy); Ghirardi, G. J. Math. Phys. (N.Y.) 14: No. 7, 815-822 (July 1973).

This work consists of two parts. First we consider a general classical relativistic direct interaction theory (for two point particles) coming from an action principle such that the equations of motion have, at most, second-order derivatives of the position 4-vectors with respect to proper time. We introduce the general formalism, derive the explicit form of the conserved quantities, and discuss some particular cases which had previously been considered in the literature. We analyze in detail the circular orbit solutions of the general equations of motion, deriving in particular the constraints which the interaction function must satisfy in order that such solutions exist. In the second part we study in detail the nonrelativistic limit of the theory, showing that the limit is perfectly consistent. The obtained Newton equations contain an arbitrary potential that depends on the relative position and velocity. (auth)

31783 GEODESIC MOTIONS IN THE TOMIMATSU-SATO METRIC. Bose, S.K.; Wang, M.Y. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. D 8: No. 2, 361-364 (15 July 1973).

A solution for the geodesic motions in the gravitational field of a rotating body due to Tomimatsu and Sato are studied. (auth)

31784 POSSIBLE IMPROVEMENTS OF GRAVITATIONAL ANTENNAS. Bonazzola, S.; Chevreton, M. (Groupe d'Astrophysique Relativiste, Département d'Astrophysique Fondamentale, Observatoire de Meudon, 92 Meudon, France). Phys. Rev. D 8: No. 2, 359-361 (15 July 1973).

The optimization of a gravitational antenna is studied in this paper. It is shown that the gravitational cross section of a conical antenna is 20% larger than that of a cylindrical one. A conical antenna is less suitable for use with ceramic transducers; however, when capacitative detectors are employed, its sensitivity can be improved by a factor of about 5 with respect to cylindrical antennas. (auth)

31785 RESTRICTED PROOF THAT THE WEAK EQUIVALENCE PRINCIPLE IMPLIES THE EINSTEIN EQUIVALENCE PRINCPLE. Lightman, A.P.; Lee, D.L. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. D 8: No. 2, 364-376 (15 July 1973).

Schiff has conjectured that the weak equivalence principle (WEP: free-fall trajectories independent of test-body composition) implies the Einstein equivalence principle (EEP: all nongravitational laws of physics the same in every freely falling frame). This paper presents a proof of Schiff's conjecture, restricted to (i) test bodies, made of electromagnetically interacting point particles, that fall from rest in a static, spherically symmetric gravitational field; and (ii) theories of gravity within a certain broad class—a class that includes almost all complete relativistic theories that we have found in the literature, but with each theory truncated to contain only point particles plus electromagnetic and gravitational fields. The proof shows that every "nonmetric" theory in the class (every theory that violates EEP) must violate WEP. A formula is derived for the magnitude of the violation. Comparison with the results of Eötvös-Dicke-type experiments rules out various nonmetric theories, including those of Belinfante and Swihart and of Naida and Capella—theories that previously were believed to agree with all current experiments. It is shown that WEP is a powerful theoretical and experimental tool for constraining the manner in which gravity couples to electromagnetism is gravitation theories. (auth)

31786 STATIC GRAVITATIONAL FIELDS. II. RICCI ROTATION COEFFICIENTS. Das, A. (Department of Mathematics, Simon Fraser University, Burnaby 2, British Columbia). J. Math. Phys. (N.Y.) 14: No. 8, 1099-1105 (Aug 1973).

Investigations of static gravitational fields in paper I are continued further. Instead of the system of second order partial differential equations in I, the equivalent first order system involving the Ricci rotation coefficients is dealt with here. The algebraic and the differential dependences among the equations have been sorted out to prove that the system is determinate. Then an attempt towards classifying this system of partial differential equations has been made. Except for "the potential equation" which is obviously elliptic, the remaining system is hyperbolic for which the characteristic surfaces have been determined. To obtain some exact solutions the lead of Newman-Penrose is followed in constructing the complex linear combinations of the equations. The class of static universes where "gravitational lines of force" are geodesics have been found. In this class one subclass is transformable to the conformastat metric and the remaining one reduces to a new metric involving the gravitational field of an arbitrary number of parallel infinite plates clamped at infinity. The source at infinity corresponds to that of the Newtonian potential $\phi = (1/2)[m + 1/2(x^1)^2 - (1/2)[m + 1/2 - (m^2 - 1/4)^{1/2}] (x^2)^2 - (1/2)(m + 1/2 + (m^2 - 1/4)^{1/2}](x^3)^2]$. This metric belongs to the nondegenerate Type I of Petrov's classification scheme. Next the class of static universes with "shearfree lines of force" is obtained. Here too one subclass goes over to the conformastat metric and the remaining one reduces to a Weyl-type universe. (auth)

31787 IMPLICATIONS OF CLASSICAL TWO-TENSOR GRAVITY. Aichelburg, P.C. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 8: No. 2, 377-384 (15 July 1973).

We discuss implications of f-g gravity on the level of classical field theory, with special emphasis on its metric structure. We show that although space-time is "bicausal," f-g theory reduces to general relativity in the limit of weak static fields. The discrepancy between the degrees of freedom of the linearized and full theory is discussed. Further, we review all known exact solutions and give a new exact nonvacuum solution. (auth)

31788 UNIQUENESS OF THE TIME COORDINATE FOR CERTAIN SINGULAR SPACE-TIMES IN GENERAL RELATIVITY. Goorjian, P. (Department of Mathematics, University of Delaware, Newark, Delaware, 19711). J. Math. Phys. (N.Y.) 14: No. 7, 986-987 (July 1973).

Many singular space-times are described locally in geodesic normal coordinates with the singularity described by the time coordinate equal to zero. Under appropriate conditions the time coordinate in this description is uniquely determined. Furthermore, every timelike curve in the coordinate patch is inextendible and has the same limit point as exactly one time coordinate line. The proof of uniqueness of the time coordinate employs methods from the theory of first order partial differential equations in a new way. (auth)

31789 A SPACE-TIME CALCULUS BASED ON PAIRS OF NULL DIRECTIONS. Geroch, R. (Department of Physics, University of Chicago, Chicago, Illinois 60637); Held, A.; Penrose, R. J. Math. Phys. (N.Y.) 14: No. 7, 874-881 (July 1973).

A formalism is presented for the treatment of space-times, which is intermediate between a fully covariant approach and the spin-coefficient method of Newman and Penrose. With the present formalism, a pair of null directions only, rather than an entire null tetrad, is singled out at each point. The concept of a spin- and boost-weighted quantity is defined, the formalism operating entirely with such quantities. This entails the introduction of modified differentiation operators, one of which represents a natural extension of the definition of the operator which had been introduced earlier by Newman and Penrose. For suitable problems, the present formalism should lead to considerable simplifications over that achieved by the standard spin-coefficient method. (auth)

REACTOR TECHNOLOGY AND REGULATION

31790 NUCLEAR ENERGY. Nazzer, D. B. (Deuterium of Canada Ltd., Sydney, Nova Scotia). Can. Mining Met. Bull.; 65: No. 727, 89-92(Nov 1972).

A brief survey of nuclear power development in Canada is presented. Comparison is made between nuclear and fossil-fueled power plants with respect to economics and energy needs. Several phases of the nuclear power program are discussed. These include topical mention of nuclear fission process, production of natural uranium fuels, chemical separation of fission products, and environmental aspects of spent fuel management. (CA)

31791 NUCLEAR REACTOR PLANT WITH INTEGRAL ENTOMBMENT. Weinstein, A. A.; Nakache, F. R.; Soodak, H. (to United States Atomic Energy Commission). U. S. Patent 3,755,079. 28 Aug 1973. Filed date 12 Dec 1969. 8p.

A nuclear reactor installation is described comprising a shield structure having a reactor chamber and a burial chamber communicating with the reactor chamber, and means operating within the shield structure for moving the pressure vessel at the expiration of its operational life from the reactor chamber into the burial chamber. (Official Gazette)

31792 REACTOR CONSTRUCTION: NEWS FROM KWU. Nuclear Interests Are Combined in KWU. Nucleus (Bonn); 19: No. 19/20, 161-163(1973). (In German).

A report is given on the organizational structure of KWU following full incorporation of the reactor departments of AEG and Siemens. Participation in daughter societies is reported. (GE)

31793 UNIPEDE CONGRESS: ENVIRONMENT IS KEY FACTOR IN FUTURE POWER GROWTH. Elec. Rev.; 193: No. 9, 280-282(31 Aug 1973).

The subjects discussed at the UNIPEDE Congress at the Hague are pollution by fossil fired plants and nuclear waste, operating experience with nuclear power reactors in Europe, the outlook for nuclear stations in power station construction, and the structure of the future Eurogrid. (UK)

31794 IDLE COOLING OF A STEAM OR GAS REACTOR. Ernst, H. (to Licentia Patent Verwaltungs GmbH). German Patent 1,809,406. 11 Jun 1970. Filed date 16 Nov 1968. (In German).

Idle cooling of a steam- or gas-cooled reactor with a two-phase flux, the composition of which is variable during the filling process and the Lenz process is characterized by the fact that above or below the core there is arranged on the diameter of the core according to the nuclear structure provision a vaporization system fed during the idle cooling phase by a bellows that introduces the coolant into the core. (TSS)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 29762, 31803, 31892, 31939–31941, 31945, 31946, 31952–31968, 31971–31981, 31986–31988, 31994–31998, 32003–32007, 32013–32016, 32025–32030, 32034, 32035, 32044–32051, 32065–32067, and 32070.

31795 (CONF-720823-P1, pp 182-206) IMPROVED BWR OFF-GAS SYSTEMS. Michels, L. R.; Horton, N. R. (General Electric Co., San Jose, CA). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The improved offgas system comprises catalytic recombiners which reduce gas volume by removing the radiolytic hydrogen and oxygen plus dynamic charcoal absorbers which operate at ambient temperature and provide selected holdup to permit Kr and Xe decay and trapping of daughters within the charcoal matrix. A roof vent may replace the plant stack. The ambient system has been in successful operation for about 5 years at the KRB reactor in Germany. G.E.'s newest offgas system features catalytic recombiners along with desiccant type air driers and dynamic charcoal adsorbers operated in the range from 0°F to minus 40°F. For relatively large charcoal systems, the holdup time for a particular isotope at a given temperature varies directly with charcoal mass and inversely with gas flow. For this reason, it is important to keep air inleakage into the main condensers at a minimum. Data are provided on BWR main condenser air inleakage, summarized literature values of dynamic adsorption coefficients (K values), along with calculations of activity and gamma dose reduction factors as a function of several of the system parameters. 6 references. (auth)

31796 (TID-26459) TECHNICAL REPORT ON DENSIFICATION OF GENERAL ELECTRIC REACTOR FUELS. (Atomic Energy Commission, Washington, D. C.). 23 Aug 1973. 73p. Dep. NTIS $5.75.

Fuel densification mechanisms and effects; the models used to predict the consequences of fuel densification; and essential elements of analyses required to determine the effects of fuel densification on reactor normal operating modes, anticipated transients, and possible accident sequences are presented. It is concluded that irradiation induced densification occurs to 96.5% of theoretical density (geometric) in BWR fuels and when the reactor is operated at substantial power, densification is instantaneous. Fuel densification causes the fuel rod to contain stored energy, increases the linear heat generation rate, decreases heat transfer between the fuel pellet and cladding, and creates the potential for a power spike in the collapsed section of the fuel rod. (FS)

31797 DEBUGGING THE BIGGER BOILING WATER REACTOR IN THE F.G.R. Nucl. Eng. Int.; 18: No. 208, 717-720(Sep 1973).

The first completely direct cycle BWR in Germany, the 600 MW(e) nuclear station Wurgassen, incorporated a considerable amount of new design and suffered a number of early setbacks. The main areas of trouble were the steam-water separator devices, the pressure suppression blow-down system, and pipework fittings. Details of the problems encountered and methods of dealing with them are described. (UK)

31798 CATALYTIC RECOMBINERS FOR BOILING WATER REACTORS. Rogers, W. M.; Lechelt, R. H. (Engelhard Industries, Inc., Newark, NJ). Nucl. Eng. Int.; 18: No. 208, 711-715 (Sep 1973).

The design, performance, and cost of catalytic recombiners for nuclear power plant off-gas systems will be significantly affected by the following features: choice of diluent, condensing or non-condensing, catalyst type selected, i.e. pelletized, honeycomb or wire mesh; preheat temperature; effluent specifications; air inleakage specifications; pressure drop specification; vessel materials selected; and number of recombiner stages used. These are discussed and detailed schemes are shown for recombiners using either steam or a non-condensing recycled diluent. (UK)

31799 CONDENSER-TYPE GAS COMBINER. Henrie, J. O. (to North American Rockwell Corp.). US Patent 3,755,075. 28 Aug 1973. Filed date 25 Mar 1970. 10p.

A condenser-type gas combiner, intended primarily for use with nuclear reactors, is designed wherein hydrogen and oxygen are recombined at low pressures using a condenser as a driving force to transport the hydrogen and oxygen gases through a catalytic bed. Two embodiments are described for use with water-boiler (homogeneous and large boiling-water reactors. (Official Gazette)

31800 REACTOR CONTAINMENT. International Development and Experience of Swedish Plants. Eriksson, K. (Vattenbyggnadsbyraan, Stockholm). Vag-Vattenbyggaren; No. 1, 42-48(1973). (In Swedish).

Principles of construction of containments for PWR and BWR reactors are described. Experiences and construction principles of Swedish plants with containments of prestressed concrete are discussed. The procedure of pressure and leak testing norms are given. (SW)

31801 FACT BOOK ON U. S. NUCLEAR POWER PROJECTS. Eleventh Edition. New York; Electric Companies Public Information Program (1972). 176p.

Information is presented concerning the patterns of growth for nuclear power, radiation safety and public acceptance, environmental factors, and resources for the future. General information is presented for specific power reactors in the U. S. The reactors are listed under the following headings: boiling water reactors; pressurized water reactors; gas cooled reactors; breeder reactors; and unclassified reactors. (DCC)

31802 BACKGROUND NOISE FOR ACOUSTIC EMISSION IN A BOILING WATER AND A PRESSURIZED WATER NUCLEAR-POWER REACTOR. Ying, S.P. (Southwest Research Institute, San Antonio, Texas 78284); Knight, J.E.; Scott, C.C. J. Acoust. Soc. Am. 53: No. 6, 1627-1631 (June 1973).

The acoustic noise spectra from 0 to 700 kHz of a boiling water reactor (BWR) have been normalized and compared with the available noise data of a pressurized water reactor (PWR). At frequencies near 500 kHz, which is the interesting frequency range for acoustic emission technology, the hydraulic turbulent and cavitation noises of the PWR were about 0 dB for the selected normalization and the noises of the BWR varied from 0 to 15 dB for the various locations that were monitored. Since the intensity levels of acoustic emission signals are on the order of 0 to 20 dB, the PWR background noise should not completely mask them; however, the BWR noise would obliterate some weak acoustic signals in some locations but allow them to be observed in other locations. Subject Classification: 7.5, 7.8. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 31800, 31801, 31878, 31891, 31892, 31924, 31944, 31947–31951, 31969, 31970, 31982–31985, 31989–31993, 31999–32002, 32008–32012, 32018–32024, 32031–32033, 32036–32043, 32052–32064, 32068, and 32071–32079.

31803 (CONF-720823-P1, pp 228-279) ANALYSIS OF POWER REACTOR GASEOUS WASTE SYSTEMS. Binford, F. T.; Hamrick, T. P.; Parker, G. W.; Row, T. H. (Oak Ridge National Lab., TN). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The operation of radioactive waste processing equipment in a power reactor designed to reduce the effluent concentration to levels at or below those defined in the Federal Regulations is described. The technique used in system analysis is presented with emphasis on those components critical to effective effluent control. A listing and instructions for use of the computer code STEFEG used in the analysis are presented. (auth)

31804 (FIND-50413(10-73)) FIND: CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Raleigh, H. D. (ed.). Technical Information Center (AEC), Oak Ridge, Tenn.). Oct 1973. 23p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginning of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

31805 METHOD AND APPARATUS FOR FUELLING A PRESSURIZED NUCLEAR REACTOR. Whittaker, S. J. (to Atomic Energy of Canada Ltd.). US Patent 3,756,914. 4 Sep 1973. Priority date 26 Oct 1970, Canada, 6p.

A nuclear reactor fuel channel which extends horizontally and has a flap valve sealing the fuel channel is fuelled by means of a fuelling machine comprising a casing, a driven endless conveyor within the casing, a fuel stringer engaging means on the conveyor, fuel stringer guides on the conveyor, a rotatable ram having an inclined end face, and means for rotating the ram when it has opened the flap so that the inclined end face is turned away from the flap valve. By attaching the fuelling machine to a pressurized fuel channel the ram may be advanced to open the flap valve, rotated, and then retracted to allow a spent fuel stringer to be moved out of the fuel channel by the coolant flow therein until the fuel stringer is engaged by the engaging means and hauled on to the conveyor. (Official Gazette)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 29794, 30430, 31801, and 32017.

31806 (AERE-R-6527 and Suppl.) CALCULATION OF GRAPHITE CORROSION AND COOLANT COMPOSITION IN HELIUM COOLED H. T. Rs.: THE EFFECT OF BULK FLOW. Wilmore, D.; Hawtin, P. (Atomic Energy Research Establishment, Harwell (England)). Oct 1970. 13p. (RPC(CGC)P-(70)58; HL-70/5133(C14); HL-71/585(Suppl.)). Dep. NTIS (U. S. Sales Only) $3.00.

In an H. T. R. system small quantities of water vapour leak into the helium coolant. This water corrodes the graphite, yielding carbon monoxide and hydrogen as products. Under the conditions prevailing in the reactor the water gas shift reaction is likely to occur rapidly. Thus the carbon monoxide and further water vapour can react together to give carbon dioxide which also corrodes the graphite. If the rates of corrosion by water vapour and carbon dioxide are different the shift reaction affects the shape of the corrosion profile. A steady state mathematical model is described for calculating the graphite corrosion rate. As a special case the model may be used for solving the equations for the model which describes the system when the shift reaction is assumed not to occur. The rates of corrosion calculated from the present model can be used to determine the overall rate of corrosion from a reactor for the particular case of a known gas composition at the inlet to the reactor. This particular solution can be generalized to an actual reactor situation where the inlet gas composition is not necessarily known. The supplement contains the input and output from the computer program RICHTER 3. (auth)

31807 (ORNL-4870, pp 49-58) GAS-COOLED REACTOR PROGRAM. Coobs, J. H. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Coated-particle fuels are being developed for HTGR's. Coated particles and bonded fuel rods were prepared and characterized and tested to high fast-neutron fluence and burnup. Fissile particles derived from uranium-loaded ion exchange resins were shown to be a viable alternative to the carbide or mixed-oxide fissile particles presently specified. Performance of BISO-coated ThO_2 particles with reference design coatings was more than adequate, and the behavior of particles with less conservatively designed coatings could be correlated with a performance model. Fuel rod specimens prepared by slug-injection bonding with coal-tar pitch containing natural flake graphite performed well when irradiated to the design HTGR fast-neutron fluence of 8×10^{21} neutrons/cm^2. However, examination of polished sections revealed a potential problem in the directional migration of ThO_2 kernels at the higher temperatures. Fuel rod specimens prepared by molding or extrusion have lower fuel loadings and improved physical properties, and such rods performed very well when irradiated to the same fluence and heat ratings. Fuel elements are also being developed for a gas-cooled fast breeder reactor (GCFBR). Postirradiation examination was made of a manifolded-vented fuel pin successfully irradiated to an exposure of 53,000 MWd/t, and a second such test of a vented element (GB-10) is being carried out. (auth)

31808 (ORNL-4870, pp 64-65) MOLTEN-SALT REACTOR PROGRAM. Weir, J. R. Jr.; McCoy, H. E. Jr. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Experience with the MSRE showed that Hastelloy N was embrittled by thermal neutrons and formed shallow intergranular cracks likely due to the fission product Te. The addition of 2% Ti seems like a suitable solution to both problems. Graphite with suitable dimensional stability in a fast neutron fluence has been produced by two vendors and in experimental quantities at ORNL. Pyrolytic carbon coatings on graphite to prevent ^{135}Xe absorption were produced and shown to remain impermeable to high neutron fluences. Molybdenum, graphite and T-111 (Ta-8% W-2% Hf) are candidate materials for use in a chemical processing plant in contact with Bi and fuel salt. A test facility constructed of Mo was designed and partially fabricated before this program was terminated. (auth)

31809 (ORNL-4870, pp 66-76) THORIUM UTILIZATION. Lotts, A. L. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

The Thorium Utilization Program is being conducted within the context of the National HTGR Fuel Recycle Program Plan. Head-end processes and chemical processes are being developed for refabrication of HTGR fuel that is obtained in the Th-^{233}U fuel cycle. The ultimate aim is to demonstrate economic fuel recycle techniques for this reactor in a pilot-scale facility, the Thorium-Uranium Recycle Facility. The program consists of refabrication process development on an engineering scale, development of remote pilot-scale equipment, and fuel cycle economic analyses. Processes and equipment are being developed to fabricate 25 kg/day of oxide fuel into the HTGR graphite fuel blocks. The demonstration with ^{233}U is now scheduled to start in TURF in 1980. 7 figures, 35 references. (DLC)

31810 IMPROVEMENTS IN OR RELATING TO CLOSED CYCLE GAS TURBINE SYSTEMS. Burylo, P. S.; Hughes, D. J. (to English Electric Co., Ltd.). British Patent 1,319,034. 31 May 1973. Filed date 22 Jan 1971. 10p.

Reference is made to closed-cycle gas turbine systems inte-

grated with nuclear reactors. On loss of load, it is necessary for quick action to be taken to shut down the turbine so as to prevent overspeed and damage. In the arrangement described, a bypass valve is provided that prevents further exhaust of gas from the turbine gas outlet, feeds part of the gas supply to the gas outlet so that, at least initially, it flows to the power turbine in a reverse direction, thereby rapidly destroying the pressure drop, and feeds the remainder of the gas supply to a cooling means. An auxiliary valve arrangement is also provided that, in conjunction with the bypass valve, diverts the gas supply for the compressor-driving turbine to the cooling means when it is of excessively high temperature. The cooling means is arranged so that resistance to gas flow through it is substantially the same as the resistance through the power turbine, in order to prevent overspeed of the compressor-driving turbine when the bypass valve is operated to isolate the power turbine. The compressor-driving turbine gas outlet is connected by a duct to the power turbine gas inlet so that under normal conditions the gas exhausted from the compressor-driving turbine passes along the duct to the power turbine gas inlet, and the bypass valve includes a valve arranged in a side duct connecting at one end with the first duct and at the other end with the cooling means. A second valve is provided in the power turbine outlet duct, and a third valve arranged in a second duct connecting the first duct with the gas outlet of the power turbine, so that, with the first and third valves open and the second valve closed, part of the gas exhausted from the compressor turbine gas outlet passes through the first valve to the cooling means and the rest flows through the third valve to the power turbine gas outlet to rapidly destroy the pressure drop; closure of the second valve prevents exhaust of gas from the power turbine gas outlet. Opening of the first and third valves and closure of the second valve are arranged to take place simultaneously. The second and third valves are mechanically interconnected. Construction of the valves is described. (UK)

31811 FUEL ELEMENT FOR NUCLEAR REACTORS. Ballagny, A. (to Commissariat a l'Energy Atomique). French Patent 2,142,823. 25 Jun 1971. 6p. (In French).

An improvement to fuel elements for high temperature gas cooled reactors provides improved behavior under irradiation and avoids rupture of the fuel pellets. The element, which is provided with a cylindrical graphite can, is in the form of two tubular coaxial envelopes closed at their ends with plugs and defining an annular space in which the cylindrical fissile material pellets are stacked. An internal envelope of the can is provided with at least one longitudinal slit, which crosses the entire thickness of the envelope. The width of this slit must be such as to compensate for the relative deformation of the envelope and of the pellets, but must be small enough to avoid the transfer of particles of the fuel into the helium gas coolant. (FR)

31812 NUCLEAR WATER CRACKING. Barnert, H. (Kernforschungsanlage, Juelich, Ger.). Atomwirt., Atomtech.; 18: No. 8-9, 408-410(1973). (In German).

A novel system is under consideration for the future supply of energy in which nuclear energy forms the primary energy source and hydrogen is the actual power source. The hydrogen would be obtained from water by a thermochemical cycling process. The particular advantages of this system include a favorable price to the consumer, universal applicability and absence of environmental pollution. The pebble-bed high-temperature reactor appears particularly favorable as the nuclear energy source. (GE)

31813 CHANCES OF NUCLEAR PROCESS HEAT. Wiss., Wirt., Polit.; 2: No. 51, 7-8(1972). (In German).

The possibilities of producing and applying nuclear process heat for high temperature reactors are economically compared to fossil fuels. (GE)

Power Reactors, Non-Breeding, Otherwise Moderated

31814 (AAEC/E-293) EQUICORE II: A TWO DIMENSIONAL COUPLED HYDRAULIC-NEUTRONICS CODE FOR CALCULATING THE EQUILIBRIUM AND TIME DEPENDENT BURNUP STATES OF PRESSURE TUBE TYPE REACTORS. Hesse, E. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1973. 79p. Dep. NTIS (U. S. Sales Only) $6.00.

The Equicore II code calculates the burnup, power distribution, and coolant conditions of pressure tube type reactors for both the equilibrium and time dependent core conditions. The code has been designed to be both easy to use and economic in computing time. To achieve this, the overall core burnup and hydraulic performance is obtained by considering only a few representative fuel assemblies and by using flux distributions derived from an RZ-diffusion calculation, based on volume elements containing the average properties of these representative fuel assemblies. A separate RZ supercell calculation model is available to determine the detailed flux and power variation between selected fuel assemblies and the average properties within radial zones of the core. The code also incorporates a user-oriented facility which allows, at any stage of the burnup calculation, the determination of such things as space dependent temperature coefficients and time dependent variation of xenon concentration. (auth)

31815 (AEEW-R-692) DETERMINATION OF RADIAL AND AXIAL POWER DISTRIBUTIONS IN THE WINFRITH SGHWR. Blackman, T. E.; Siudek, R. S. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Feb 1970. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

Declassified Aug 1973.

Routine monitoring of radial power distributions in the Winfrith SGHWR is effected using venturi flow and quality meters. An alternative method based on the neutron activation of copper-bearing wires is described. In addition to establishing confidence in the results obtained from the quality meters, this method will also provide data on axial rating distributions. The accuracy of the method is discussed in relation to a scan made shortly after the start of reactor life. (auth)

31816 NUCLEAR POWER: STATE OF THE ART AND FUTURE EXPECTATIONS. Gray, J. L. (Atomic Energy of Canada Ltd., Ottawa). Can. Mining Met. Bull.; 66: No. 734, 60-64(Jun 1973).

A brief overview of the Canadian nuclear power program is presented. Reference is made to presently developed and committed facilities as well as to probable future programs. The state of development of pressurized heavy water reactors is stated to be commercially successful. Mention is made of alternative Canadian systems such as the boiling light water (BLW) reactor and an organic liquid cooled reactor (OCR). A prototype BLW power plant is in operation although scaleup from 250 MW(e) to a commercially viable 750 MW(e) requires the use of plutonium-enriched fuel. Organic-cooled reactors offer several advantages among which are higher thermal efficiency and a nonradioactive primary coolant. This latter system, however, has not been developed beyond the experimental stage to date. An estimate of needs to the year 2000 indicates that Canada need not develop fast breeder systems to enhance power production. A scheme is presented whereby future Canadian reactors operating on a thorium fuel cycle may be used for thermal "near-breeding" of uranium-233. (CA)

31817 APPLICATION OF VARIOUS WELDING PROCESSES TO THE AG3 USED IN THE CONSTRUCTION OF THE GRENOBLE HIGH FLUX REACTOR. Debru, M. (Institut Max von Laue–Paul Langevin, Grenoble, France); Chevallier, R.; Jean, A. Soudage Tech. Connexes; 27: No. 5, 181-205(May 1973). (In French).

From meeting of the welding society; Paris, France (26 Oct 1972).

A description of the High Flux Reactor is given including the core, fuel element, experimental channels, and cold source. The general conception of the block pile is presented together with that of the reflector tank and the upper structure. AG3 alloy is used for the construction of the block pile because of its transparence to neutrons and its good thermal conductivity. The welding methods used for the construction of the reflector tank for the upper structure are described. The control procedures and the welded joints are discussed. (FR)

Power Reactors, Breeding

Refer also to abstracts 29933, 31801, 31807, 31877, 31881, 31893, 31895, 31933, 31938, 31942, and 31943.

31818 (ANL-RDP-18) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JULY 1973. (Argonne National Lab., Ill.). 29 Aug 1973. Contract W-31-109-Eng-38. 185p. AT.

Progress in LMFBR development studies is reported under the following headings: EBR-2; hot fuel examination facility; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; and environmental studies. (JWR)

31819 (RDT-M-13-1-T(9-73)) SODIUM PURCHASE SPECIFICATIONS. (Division of Reactor Research and Development (AEC), Washington, D. C.). Sep 1973. 5p. RSO.

The purity, quality assurance, and delivery requirements for the procurement of bulk sodium for use in sodium cooled fast breeder reactors and in nonreactor test and experimental systems are presented. (FS)

31820 (WAPD-TM-1062) ENERGY DEPENDENT SPATIAL MESH APPROXIMATION FOR NEUTRON GROUP DIFFUSION PROBLEMS (LWBR DEVELOPMENT PROGRAM). Yasinsky, J. B.; Natelson, M. (Bettis Atomic Power Lab., Pittsburgh, PA). Jun 1973. Contract AT(11-1)-Gen-14. 67p. Dep. NTIS $5.50.

A spatial differencing approximation is derived for neutron group diffusion problems which permits the use of different mesh grids in different energy groups. Such an approach results in reduced computer run-times relative to the standard energy independent mesh method. Results of numerical examples indicate that eigenvalues and power distributions obtained from the energy dependent mesh method are comparable in accuracy with those obtained from corresponding energy independent mesh differenced solutions. (auth)

31821 (WARD-OX-3045-2) OXIDE FUEL ELEMENT DEVELOPMENT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1973. Boltax, A.; Saling, J. H. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Sep 1973. Contract AT(11-1)-3045. 123p. AT.

Progress in the development and testing of stainless steel clad mixed oxide fuel pins for LMFBR's is reported. Fabrication, irradiation, and post irradiation examination of EBR-2 assemblies are described. Information on radiation effects on Type 304 and Type 316 stainless steel cladding is presented. (JWR)

31822 (WARD-RB-3045-2) RADIAL BLANKET DESIGN AND DEVELOPMENT. Quarterly Progress Report for Period Ending May 31, 1973. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Sep 1973. Contract AT(11-1)-3045. 83p. AT.

Progress in the design and development of LMFBR radial blankets during the quarter is reported. The research included heat transfer tests and EBR-II irradiation studies. (JWR)

31823 SEGMENTED HYDRAULIC CORE CLAMP. Stelle, A. M. (to North American Rockwell Corp.). US Patent 3,755,078. 28 Aug 1973. Filed date 27 Dec 1971. 8p.

A clamping device for nuclear reactor cores is described wherein a plurality of hydraulic cylinders act directly to open or close a tilting segment core clamp. The clamp exerts a radial inwardly directed force of constant magnitude on the reactor core yet is releasable upon reversing the direction of fluid on a piston within the hydraulic cylinders thereby releasing the fuel elements within the core. (Official Gazette)

31824 METHOD FOR DETECTING AND LOCATING FAILED SODIUM-BONDED FUEL ELEMENTS. Meyer, R. J.; Johnson, C. E.; Grouthamel, C. E. (to United States Atomic Energy Commission). US Patent 3,746,614. 17 Jul 1973. Filed date 29 Sep 1972. 8p.

A method is given for detecting and locating failed sodium-bonded fuel elements in a liquid-sodium-cooled nuclear reactor. A mixture of any two of the three stable isotopes ^{197}Au, ^{121}Sb, and ^{198}Pt is dissolved in the sodium bonding in each of a plurality of unirradiated sodium-bonded fuel elements. The fuel elements within each subassembly or group of fuel elements contain an isotopic mixture of the same predetermined weight ratio of the two selected isotopes. Gamma-spectrometric assay of the primary sodium coolant will detect the isotopes' activation products released into the coolant by a fuel element failure and determine the activity ratio thereof to indicate which subassembly contains the failed fuel element. (Official Gazette)

31825 SINGLE FLUID MOLTEN SALT NUCLEAR BREEDER REACTOR. Bettis, E. S.; MacPherson, H. G.; Perry, A. M.; Smith, O. L. (to United States Atomic Energy Commission). U. S. Patent 3,743,577. 3 Jul 1973. Filed date 3 Jun 1968. 8p.

A molten-salt-fueled graphite-moderated nuclear breeder reactor characterized by a single salt mixture containing both fissile and fertile material which serves as both fuel and blanket fluid. The reactor is divided into core and blanket regions which are distinguished by the degree of neutron moderation provided therein. The degree of neutron moderation in the core and blanket regions may be varied by varying the volume fraction of salt mixture present in each region, by varying the density of the graphite moderator in each region, or by a combination of the two methods. The composition of the salt mixture and the neutron moderation provided in each region are selected so that neutron absorption by the fissile material predominates in the core and absorption of neutrons by the fertile material predominates in the blanket region. (Official Gazette)

31826 NUCLEAR FUEL ASSEMBLY. Agranier, J. C.; Chalony, A. (to Commissariat a l'Energie Atomique). US Patent 3,755,077. 28 Aug 1973. Priority date 17 Sep 1969, France. 4p.

A fastening system for retaining a compact bundle of fuel pins longitudinally in the fluid coolant guide shroud of a nuclear fuel assembly comprises two parallel rods attached transversely to a tube retained by the shroud and contained therein, parallel rails which slide on the rods and split tubes which each slide on a rail and slide thereon and in the plugs of the fuel pins of a same layer to retain the pins on the rail. The guide members are retained by the shroud. The assembly is suitable for use in high power-density reactors such as the LMFBR. (Official Gazette)

31827 FUEL ELEMENT DEVELOPMENT PROGRAM. Boyer, P. (CEN de Cadarache, Saint-Paul-les-Durance, France); Clottes, G.; Leclere, J.; Ratier, J. L.; Ginier, R. Bull. Inform. Sci. Tech. (Paris); No. 182, 23-27(Jun 1973). (In French).

The fuel element of the 1200 MW(e) is made of UO_2PuO_2 with a 316 ASTM steel canning such as that of Rapsodie. The design of the fuel element has been simplified with both axial blankets completely integrated which ensures an improved Pu conversion rate. The fuel pellets are 7 mm diameter. Testing programs are envisaged for studying swelling and corrosion of the steel cans under neutron irradiation. (FR)

31828 DESIGN OF THE CORE AND ASSEMBLIES OF A 1200 MWe FAST NEUTRON REACTOR DEVELOPMENT PROGRAM. Clauzon, P. (CEN de Cadarache, Saint-Paul-les-Durance, France); Estavoyer, M.; Marmonier, P.; Mougniot, J. C.; Pontier, M.; Skok, J.; Leclere, J. Bull. Inform. Sci. Tech. (Paris); No. 182, 13-21(Jun 1973). (In French).

The problems encountered during the study of the core of a 1200MW(e) fast power plant are presented. The test and development programs are described. A description of the core and the design of the main subassemblies are given. (FR)

31829 MAIN COMPONENTS IN HIGH POWER FAST BREEDER REACTORS. Kayser, G. (CEN de Cadarache, Saint-Paul-les-Durance, France); Robin, G.; Duchatelle, L.; Birault, J.; Schwab, B.; Lions, N.; Biscarel, J.; Lafon, A. Bull. Inform. Sci. Tech. (Paris); No. 182, 39-52(Jun 1973). (In French).

The increasing dimensions of fast breeder reactors' main components such as steam generators, intermediate heat exchangers, and pumps raise problems in design manufacture and testing. These problems can be solved by extrapolating the Phenix solutions; but in certain cases it is necessary to maintain a development program for part of the components. The steam generators for the 1200 MW(e) reactor are different from that of Phenix for simplicity and economy. (FR)

31830 CONTRIBUTION OF THE RESEARCH CENTERS TO THE SNR 300. Engelmann, P. (Kernforschungszentrum, Karlsruhe, Ger.); Coehoorn, J.; de Haas van Dorsser, A. H.; Goens, J. (1973). vp. (In German).

From fast breeder status report conference; Bensberg, Germany. (20 Mar 1973).

The following subjects are briefly described: neutron and reactor physics; safety of SNR-type reactors; technological development work; fuel rod and materials development; and transport, and reprocessing of SNR fuel elements. (GE)

31831 STOP VALVE FOR LIQUID METAL CYCLES. Markfort, D. (to Interatom Internationale Atomreaktorbau). German Patent 1,902,454. 13 Aug 1970. Filed date 18 Jan 1969. (In German).

A stop valve for liquid metals such as coolants for reactors cooled with liquid sodium is characterized by the fact that sealing plates are arranged on a pivoting arm provided with a cavity, into which the excentric extension of a motorized shaft penetrates. A sleeve as well as the pivoting arm in the valve box is provided with a stop on the interior. (TSS)

31832 ENGINEERING OF US FAST BREEDER REACTORS FOR SAFE AND RELIABLE OPERATION. Kintner, E. E. (Atomic Energy Commission, Washington, DC). pp 9-28 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

While providing for accidents, emphasis is placed on design features which prevent accidents or mitigate their consequences. This is accomplished by a process involving three levels of design for safety: execution and building of a sound, conservative, inherently safe design; provision of protection systems designed to assure off-normal events will be prevented, arrested or accommo-

dated safety; and evaluation and provision of features which add margin as additional assurance of public safety even for extremely unlikely and unforeseen circumstances. The design of the Fast Flux Test Facility where considerable degradation of performance and extra cost has been incurred to provide inherently safe features and engineering margins is described. The extensive safety research and development program now being carried out to provide data and confirmation of analytical methods being used to design and assess these special safety features is also described. (INIS)

31833 RELIABILITY OF FAST REACTOR STEAM GENERATORS. Taylor, D. (Nuclear Power Group Ltd., Knutsford, Eng.); Bennett, J. C. pp 65-91 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Ger. (9 Oct 1972).

The production of economic electrical power from sodium cooled fast reactors demands a high degree of reliability from the steam generators which must be achieved without large capital cost expenditure. Major economic penalties are associated with certain types of sodium water reaction which may result from a tube wall leak. The assessment of these penalties and their comparison with the investment in extra reliability are analyzed. Design and manufacturing features aimed at increasing availability, including the application of experience gained in the procurement of the P. F. R. heat exchangers, are highlighted. The main theme is design simplicity and utilization of familiar and well tried technique. Control of the operational environment, fast identification of leaks and rapid repair and maintenance are also important design considerations discussed. (INIS)

31834 MINIMIZING TRANSIENT EFFECTS IN LMFBRS. De Boer, G. A. (Neratoom, The Hague); De Hes, M.; Evers, H. O.; Niebel, H. pp 92-115 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

For the design of LMFBRs a good knowledge of the transient behavior is necessary. On the SNR-300 heat-transfer system, consisting of reactor, primary circuit, intermediate heat exchanger, secondary circuit, steam generator and water-steam circuit, several studies have been performed. Digital and hybrid computer programs have been developed to study the transient behavior of the plant and its components with and without control loops for all kinds of operational conditions and perturbations. The digital programs are especially suited to calculate the temperature transients in single circuits or components directly after the perturbation has occurred, for example a reactor scram, due to high model accuracy and long computer times. The hybrid program is mainly used for control and stability studies and to study perturbations over longer periods of time. Both kinds of programs calculate the temperatures at the inlets and outlets of all components as well as the temperature distribution in the heat exchanging components. (INIS)

31835 HEAT REMOVAL SYSTEMS DESIGN FOR SODIUM COOLED FAST REACTORS. Cobb, E. C.; Leigh, K. M. (Nuclear Power Group Ltd., Risley, Eng.). pp 44-64 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Ger. (9 Oct 1972).

The heat removal systems required for fast reactors employing the pool design concept being developed in the UK are described and illustrated, with references to the Prototype Fast Reactor which is nearing completion of construction. (INIS)

31836 PHENIX EMERGENCY COOLING SYSTEM. Megy, J. M. (CEA, Paris); Guidicelli, A. G.; Robert, E. A.; Cretee, J. P. pp 336-349 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). (In French).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The normal decay heat rejection systems are first presented. Incidents being able to lead to the loss of these normal means are then analyzed. The protective system and its constructive characteristics designed for emergency cooling and based on two independent and highly reliable circuits entirely installed outside the primary containment vessel are described. (INIS)

31837 SAFETY ASPECTS OF THE DESIGN OF HEAT TRANSFER SYSTEMS IN LMFBR'S. Keaten, R. W.; Bell, C. R.; Drucker, G. S.; Hart, R. S.; Presson, A. G. (Atomics International, Canoga Park, CA). pp 133-150 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The potential system faults which can have the most important impact on heat transfer system design are: reactor trip and resulting temperature transients; loss of normal heat removal capability; entrainment and collection of gas bubbles; sodium leaks; steam generator leaks resulting in sodium-water reactions; and a hypothetical core disruptive accident. In general, three types of protection may be required for such faults: inherent design features to prevent the fault from occurring, protective devices to prevent plant damage if the fault occurs, and containment and other engineered safety features to protect the public if the protective devices fail. These features are discussed with reference to the Atomics International design of an LMFBR demonstration plant. (INIS)

31838 DESIGN OF SNR: PRINCIPLES AND ACHIEVEMENTS. Traube, K. (INTERATOM, Bensberg, Ger.). pp 153-181 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). (In German).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The construction of the 300 MW(e) LMFBR prototype SNR 300 will start in 1973. During the erection phase, industry will be responsible for the project. The main differences between the SNR-300 and the earlier European prototypes, PFR and Phenix are the international cooperation, the industrial organization of the project—SNR will be built under a commercial turnkey contract between a utility (SBK) and a manufacturer (INB)—, a licensing procedure adapting the most recent German licensing standards, and the use of the loop concept rather than the pot concept for the primary system. In the next phase of fast reactor development, that of the first quasi-commercial large breeder power stations, it is anticipated that the international DEBENELUX cooperation can be broadened by the participation of British nuclear industry, and that the broader base of experience will help not only industry, but also the licensing authorities in finding safety criteria which protect the public without compromise and still do not impede the industrial use of the fast breeder. (INIS)

31839 ASSESSMENT OF FERMI-1 STEAM GENERATOR PERFORMANCE. Coleman, J. H. (Atomic Power Development Associates, Inc., Detroit); Cyrulewski, J. D.; Ford, J. A.; Newton, E. H.; Tashimo, M. pp 182-202 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The results of a safety review analysis of the Fermi-1 steam generators are presented. Also described is the leak detection system and some of its performance characteristics. A review of the thermal and mechanical performance of the units is presented along with a description of the mathematical model used to analyze and predict the overall thermal performance of the units. The principal design and performance characteristics of these steam generators are enumerated and discussed. (INIS)

31840 SODIUM-WATER REACTION TESTS AND ANALYSES FOR MONJU STEAM GENERATOR. Hori, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Sato, M.; Tanaka, Y.; Sakano, K.; Watanabe, T.; Kurosawa, K. pp 203-219 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Ger. (9 Oct 1972).

To assess the safety of MONJU steam generator against sodium-water reaction, the large leak test rig (SWAT-1) was constructed and a series of tests was conducted. Also, the computer codes to analyze the large leak phenomena (SWAC-1, 3, 7) were developed and compared with the test results. The results of these large leak tests and analyses are described. (INIS)

31841 SAFETY CONSIDERATIONS IN FAST REACTOR CORE DESIGN. Holmes, J. A. G. (Nuclear Power Group Ltd., Risley, Eng.). pp 29-43 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

Safe and reliable operation of a fast reactor is vitally dependent on the core design. Particular characteristics of a fast reactor compared with a thermal reactor core which affect safety and

reliability are: the high mass rating required for economic considerations which leads to small diameter fuel pins and high heat transfer rates; the close packing of pins and absence of permanent structures within the core; and reactivity changes which occur with comparatively small variations in core geometry and fuel distribution. Considerations in fuel and subassembly design which will be discussed are fuel rating and temperature to prevent fuel redistribution and maintain fuel pin integrity for the required life; potential fuel failure mechanisms and their influence on design and operating conditions; consequences of fuel failure; fuel pin support systems from considerations of integrity and dynamic stability; fuel cooling. The major factors in design of the support of subassemblies and of the whole core are dynamic stability to limit reactivity noise and prevent mechanical damage to core and reactor components, and accommodation of the consequences of the voidage swelling of structural materials caused by neutron irradiation. The design of both free standing and clamped cores will be considered from these aspects, including reference to the selection of structural materials. Safety implications of the design of the overall core support structure will also be discussed. (INIS)

31842 SNR EMERGENCY COOLING–HEAT TRANSFER CALCULATIONS OF IN-TANK NATURAL CIRCULATION WITH BLANKET BACKFLOW. Timmermann, F.; Vossebrecker, H. (INTERATOM, Bensberg, Ger.). pp 322-335 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The SNR is equipped with an emergency cooling system whereby the decay heat is transported out of the tank by 6 sodium immersion coolers. The heat transport from the core to the coolers is realized by in-tank natural convection loops with backflow in the blanket. A special computer code has been developed which describes the dynamic behavior of the in-tank flow. Calculations have been made for an accident whereby the sodium level in the tank sinks down to the emergency level as a consequence of a rupture of a main sodium pipe with simultaneous failure of the pump shutdown. The results demonstrate that the in-tank natural convection is capable of transporting the decay heat from the fuel to the immersion coolers. (INIS)

31843 SAFETY SYSTEMS IN FAST REACTORS. Argous, J. P. pp 301-321 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). (In French).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The safety systems used in fast reactors are reviewed. The objectives pursued with these systems are indicated and details are given of present studies aiming at an improvement of the performance and reliability of these systems. (INIS)

31844 RELIABILITY ANALYSIS OF THE DECAY HEAT REMOVAL FOR SNR. Zeibig, H.; Blombach, J.; Heuser, F. W.; Rosenhauer, W. (INTERATOM, Bensberg, Ger.). pp 271-297 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

Starting with general safety considerations, the demands on the systems required for the decay heat removal are defined. These demands are quantified by the results of block consequence analyses of the whole plant assuming a tolerable total risk. Detailed investigations of the sodium pumps and the power supply system are presented. The results are used in a fault tree analysis of decay heat removal. The cases determining the safety of the plant are considered. The final results show that using quantitative reliability methods a general understanding of the systems is attained and, even more important, that the systems meet the requirements compatible with the tolerable total risk. (INIS)

31845 SPECIAL ASEISMIC DESIGN ENGINEERING AND DEVELOPMENT FOR FAST REACTOR. Kawaguchi, O. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Watabe, M.; Sasaki, S.; Akino, K.; Kato, M. pp 251-270 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The aseismic design of the graphite shielding structure, which is evaluated by vibration tests on a simulated model, and the development of an earthquake restraint device for the aseismic design of primary sodium piping for the experimental reactor JOYO and for the prototype reactor MONJU are described. (INIS)

31846 EXPERIENCE IN SODIUM TEST FACILITIES AND COMMISSIONING OF KNK WITH A VIEW TO FAST SODIUM-COOLED REACTORS. Kirchner, G.; Herberg, S.; Hendl, G.; Schaefer, U.; Albat, W. (INTERATOM, Bensberg, Ger.). pp 522-536 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 2. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). (In German).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The KNK is in its final phase of commissioning. Following the fourth partial operation license, 50% (10 MW) of the nominal electric power could be generated for the power supply grid for the first time on August 10, 1972. Commissioning had begun in November 1969 when installation work was nearing completion. The first steps were: commissioning and test of component systems without sodium; processing engineering tests under sodium conditions; fuel loading and zero-power tests; and nuclear power generation. Experience in KNK during the commissioning phase of power generation is discussed in particular with respect to the control of the decrease of the sodium heat span (160°C) after scram. (INIS)

31847 ENSURING OF SAFE OPERATION OF BOR-60 REACTOR. Kazachkovskii, O. D.; Gryazev, V. M.; Krasnoyarov, N. V.; Kevrolev, V. P.; Afanas'ev, V. A.; Smirnov, A. M.; Kondrat'ev, V. I. (Scientific-Research Inst. on Nuclear Reactors, Dimitrovgrad, USSR). pp 473-491 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 2. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). (In Russian).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The investigation results on the effects of the steady-state reactivity, of natural circulation regimes, of the emergency cooling and transients during scram system trip are presented. A description is given of the changes in the systems and in technological processes, and the operational reliability of the equipment and of the reactor systems is verified. (NTIS)

31848 CONTAINMENT DESIGN IN FAST REACTORS. Laithwaite, J. M. (Nuclear Power Group Ltd., Risley, Eng.). pp 454-469 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

In the UK containment of fast reactors is divided into two stages known as primary and secondary. Each has completely different functions. The duty of primary containment is to confine the effects of an energy release starting within the core, and for this duty it is economic to exploit the inherent strength of the reactor structure as far as possible. The secondary containment has the main function of limiting the release of active products to the atmosphere in the event of an operational accident involving the spillage of coolant or fuel within the operating areas. The approach in the UK is to provide a low pressure limited leakage building with ventilation and cleanup plant for removing particulate activity. Such buildings can be provided in shapes and sizes tailored to the operating requirements. The design basis of such buildings is considered and an example of the behavior of the PFR building in a pressurization accident is given. A brief survey is given of the choices confronting a designer in selecting the requirements of a primary containment structure. (INIS)

31849 SNR-300 AND THE INTERNATIONAL STATE OF FAST BREEDER DEVELOPMENT. Traube, K. (Internationale Atomreaktorbau, GmbH, Bensberg, Ger.). Atomwirt., Atomtech.; 18: No. 8-9, 411-414(1973). (In German).

From fast breeder status report; Bensberg, Germany (20 Mar 1973).

The delay in the SNR-300 compared with other prototypes is, in the context of future large breeder power stations, largely made up by the fact that in design, industrial handling and licensing procedures it is already strongly commercially orientated. For this reason the expenditure of the three countries which is distinctly lower than that of others appears thoroughly justified. (GE)

31850 GENERALIZED RELATIONSHIPS FOR HEAT TRANSFER IN THE FUEL ASSEMBLIES OF NUCLEAR REACTORS WITH LIQUID METAL COOLING. Bobkov, V.P.; Ibragimov, M.K.; Subbotin, V.I. High Temp. 10: No. 4, 713-720 (Mar 1973).

By using a wide range of experimental data together with appropriate simulation theory and various methods of calculating hydrodynamical flow parameters, as well as a statistical analysis of turbulent heat transfer and many different computing procedures, generalized relationships are derived for the heat-transfer coefficients and the temperature-field nonuniformities associated with the flow of molten metal in the "unit cells" of channels with cross sections of complicated shapes. (auth)

31851 PROTECTIVE INSTRUMENTATION FOR FAST REACTORS. Smith, R. D. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 381-398 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The instruments are considered in two main groups—those protecting the reactor against incidents which affect the whole core and those which protect against incidents which in the first instance affect only one subassembly. A third minor group covers instruments needed for refueling. The first group presents relatively few problems, but the development of instruments monitoring the performance of single subassemblies is more difficult, particularly because of the need to minimize spurious reactor trips. Instruments such as reactivity meters and acoustic noise detectors offer a possible solution, but may give inadequate signal to noise ratios. The proposals for protective instruments on current large fast reactor designs are tabulated. (INIS)

31852 PRINCIPLES OF DETERMINING DAMAGE TO THE FUEL ELEMENTS OF FAST POWER REACTORS BY MONITORING SODIUM AND GAS ACTIVITY. Efimov, I. A.; Kulakovskii, M. Ya.; Filonov, V. S. pp 399-416 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). (In Russian).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Ger. (9 Oct 1972).

The main requirements which have to be met by systems for determining damage to the fuel elements of fast power reactors by delayed neutrons, gas activity and sodium coolant activity monitoring are described. The influence of reactor layout, detector geometry, neutron background and gamma background on the sensitivity of such systems is examined. Theoretical data on the magnitude of the effective signal resulting from damage to fuel elements in the BN-350 and BN-600 reactors and experimental data relating to the use of such systems in determining fuel element damage during operation in the BR-5 reactor are presented. (INIS)

31853 DIRECT CONNECTION OF THE FERMI-1 MALFUNCTION DETECTION ANALYZER WITH THE PLANT SAFETY SYSTEM. Volk, E. R. (Atomic Power Development Associates, Inc., Detroit); Batch, M. L.; Cox, T. H.; Klickman, A. E.; Ziniuk, M. A.; Harrigan, P. M. pp 417-433 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The Fermi-1 malfunction detection analyzer (MDA) is an on-line computer which provides the Fermi-1 fast reactor with a means of rapidly gathering data, performing detailed calculations, and comparing measured results for the purpose of malfunction detection. The design and operational aspects necessary for direct connection of the MDA with the plant safety system are described. This has been the ultimate objective for the MDA system throughout its conception, design, and testing period. (INIS)

Research, Test, and Experimental Reactors

Refer also to abstracts 29795, 31482, 31818, 31832, 31845, and 31932.

31854 (CONF-720823-P1, pp 159-180) PARTICLE DEPOSITION AND REENTRAINMENT ON FFTF H AND V COMPONENTS FOLLOWING A SODIUM SPILL. First, M. W.; Jochem, E.; Baldwin, T. W.; Hall, R. (Harvard School of Public Health, Boston). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The purpose of sodium aerosol deposition tests underway at HACL is to examine basic sodium deposition mechanisms in heat-exchanger tubes which simulate as closely as possible the tube size, flow rates, and aerosol characteristics under consideration for the FFTF. On the basis of test data, it should become possible to predict total sodium deposition from a knowledge of particle size and concentration, flow rate, and duration for any accident condition (whether currently under study or of future interest) and make possible a prediction of the effect this is likely to have on heat transfer capability. The experiments currently conducted at HACL do not and are not intended to simulate accident conditions for the purposes of investigating "source terms" or the manner in which molten sodium vaporizes, nucleates, and cools under accident conditions. 5 references. (auth)

31855 (CONF-730301-P1, pp 263-264) 25-keV NEUTRON FACILITY AT APSARA. Kondaiah, E.; Anand, R. P.; Bhattacharya, D. (Tata Inst. of Fundamental Research, Bombay). 1973.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

In photonuclear reactions and applications.

The facility used at the Apsara reactor for producing a 25-keV neutron beam by means of an iron filter assembly is described. (LTW)

31856 (HEDL-TME-73-58) FTR CORE COMPACTION AND WITHDRAWAL TESTS. Kinsel, W. C. (Hanford Engineering Development Lab., Richland, Wash.). May 1973. Contract AT(45-1)-2170. 80p. AT.

The results of over four hundred experiments to determine the compaction and the withdrawal behavior of hexagonal ducts in a simulated FTR core are reported. The principal parameters were duct cambers, as determined by material behavior (creep or swelling), and friction coefficients. Other less significant parameters were also evaluated; these included load sequence, duct compliancy and limited free travel at the top of the duct. Compaction behavior was evaluated in terms of mean diametral gap; skew error, repeatability error and core centerline shift; withdrawal behavior was evaluated in terms of withdrawal force and applied restraint loads. (auth)

31857 (IAE-2183) EXPERIMENTS WITH URANIUM–WATER LATTICES FROM THE FUEL ELEMENTS OF A VVER-1000 REACTOR WITH ABSORBING ELEMENTS. Komissarov, L. V.; Lunin, G. L.; Epanechnikov, Yu. A.; Voznesenskii, V. A.; Andriyanov, G. A.; Ananenkov, V. V.; Andrianov, G. Ya.; Savelev, N. S. (Institut Atomnoi Energii, Moscow (USSR)). 1972. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

On uranium-water lattices consisting of fuel rods with 4.4% enriched U-235, measurements were made on the magnitude of the geometric lattice parameter, and the effect of changing the geometric parameter near the critical state of the reactivity of the system $(\partial\rho/\partial\beta^2)\,\beta_0^2$. The critical size of the lattice as a function of boric acid concentration in the moderator was experimentally investigated over a wide range. Measurements were made on the efficiency of homogeneous lattices made up of absorbers of a different degree of "greyness" installed in the place of fuel rods which were removed. These measurements were made at varying concentrations of boric acid in the moderator. Studies were also undertaken on the efficiency of the absorbing elements with various modes of placement in the uranium-water lattice. The experimental results are compared with calculations carried out by the POP program. (JSR)

31858 (INIS-mf-703) 25 keV NEUTRON BEAM FACILITY AT THE REACTOR "APSARA". Kondaiah, E.; Bhattacharya, D.; Anand, R. P. (Tata Inst. of Fundamental Research, Bombay (India)). Jan 1973. 33p. INIS.

The principle and design of the filter assembly are described. The filters are made of 15-grade aluminum and specpure sulfur and A-grade steel. The composition of the filters is adjusted to obtain maximum intensity of 25-keV neutrons from the reactor beam hole. The filters are loaded inside a larger aluminum tube with an iron plug and fitted into the beam hole. Using boron, aluminum, sulfur, and CeO_2 as absorbers and a ^3He neutron detector, the count rate vs. absorber thickness is recorded for each filter assembly and the filter assembly is changed until each absorber gives a single straight line as the transmission curve. The optimum filter assembly is taken to be the one which gives a straight line as the transmission curve. The good agreement between the measured values and the literature values at 25 keV shows that the energy of the filtered neutron beam is 25 keV. The monoenergic nature of the neutrons has been confirmed by recording the neutron spectrum on a recoil proton spectrometer. Procedures for optimizing the position of the filter assembly and estimating the neutron flux are described. The filtered beam facility is compared with other sources. (INIS)

31859 (JAERI-M-5225) EXAMINATION OF THE USED JRR-4 FUEL AND BURN-UP MEASUREMENT BY GAMMA-RAY SCAN-

NING. Adachi, M.; Matsuno, K.; Uchiyama, J.; Sato, H.; Takayanagi, H. (Japan Atomic Energy Research Inst., Tokyo). Apr 1973. 55p. (In Japanese). NTIS (U. S. Sales Only).

The count in JRR-4 by a fuel failure detector (FFD) had gradually increased from July 1968 to March 1969. Investigation was therefore made by flux-tilting and wet sipping methods, to find the failed fuel; one leaky fuel element was detected. This fuel element was disassembled in a hot laboratory, and the failed portion was disclosed. Metallurgical examination showed that the plate concerned had a large void in the fuel meat, with thinner cladding. Causes of this failure are described. To evaluate the average burnup of this fuel element, gamma-ray scanning was made on all the fuel plates. The absolute, average burnup was found to be 3.92%, by radiochemical analysis of ^{137}Cs. The difference between this and the calculated value based on the thermal-neutron flux distribution is discussed. (auth)

31860 (ORNL-4870, pp 77-80) RESEARCH REACTOR MATERIALS. Farrell, K.; Knight, R. W. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Aluminum-base materials and components used in the Oak Ridge Research Reactor and the High Flux Isotope Reactor are being studied to determine the effects of neutron irradiation on dimensional stability and mechanical integrity. These effects are summarized. The HFIR fuel plate rejection rate for this year was 3.63%. Burned U_3O_8 is being qualified, and unclad 6061 aluminum appears to be an acceptable replacement for alclad 6061 aluminum for frame and cover plates. The examination of fuel elements 100-I and 100-O is completed. Burned U_3O_8 will perform as well as or better than the present reference fuel, high-fired U_3O_8. (auth)

31861 (ORNL-4870, pp 84-86) TRANSURANIUM PROGRAM. Lotts, A. L. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

A total of 33 targets containing ^{244}Cm were fabricated for irradiation in the HFIR, and 25 of these have been inserted within the HFIR core. During the year, 22 target elements were removed from the HFIR, and burnups ranged from 36.8 to 73.7% FIMA and fluences from 4.33 to 12.38×10^{22} neutrons/cm^2 (<0.41 eV) and 1.24 to 3.27×10^{22} neutrons/cm^2 (>0.82 MeV). All these targets performed satisfactorily. In addition, three sources containing ^{252}Cf, four HFIR rabbits that contained ^{253}Es, and one that contained ^{257}Fm were prepared. Additionally, shipments of ^{252}Cf and ^{244}Cm were made to the Savannah River Plant during the reporting period. Work was also accomplished on a method for determination of the thermal conductivity of the individual target pellets in an effort to develop a technique that will nondestructively determine the suitability of the fabricated pellets to perform at the design heat fluxes. (auth)

31862 (ORNL-TM-4378) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT: APRIL, MAY, AND JUNE OF 1973. Hurt, S. S. III; Lance, E. D. (Oak Ridge National Lab., Tenn.). Oct 1973 Contract W-7405-eng-26. 59p. Dep. NTIS $5.00.

The ORR operated at an average power level of 29.8 MW for 88.4% of the time during April, May, and June of 1973. Thirteen fuel elements were declared spent (46.3% average burnup) during the quarter, while thirty-five new elements were placed in service. Two shim-rod elements were retired from service at an average burnup of 92.2%. The reactor was shut down on 12 occasions, 10 of which were scheduled. End-of-cycle shutdowns accounted for 82.3% of the total downtime, with the remainder used principally for refueling and experiment work. Maintenance activities, both mechanical and instrument, were essentially routine in nature. Special tests or measurements completed during the quarter included: (1) core flux mapping, (2) shim-rod calibration, (3) OG-1 (CP-3) reactivity check, and (4) thermal neutron flux measurements for proposed experiments. Investigation was started on the location of a 2-5 gpm water loss from the reactor primary water system. (auth)

31863 (PRNC-166) ABSOLUTE FLUX DETERMINATION USING ACTIVITY RATIO OF CONSECUTIVELY PRODUCED RADIOISOTOPES. Sasscer, D. S.; Melendez, M. R. (Puerto Rico Nuclear Center, Mayaguez). Jun 1973. Contract AT(40-1)-1833. 81p. Dep. NTIS $6.25.

Thesis. Submitted by M. S. Melendez to Puerto Rico Univ., Mayaguez.

Absolute thermal neutron flux was measured in the P.R.N.C. Triga Flip reactor using the activity ratio of the radioisotopes ^{165}Dy and ^{166}Dy, consecutively produced by thermal neutron absorption in ^{164}Dy. The theory and conditions on this method for neutron flux measurements were given a detailed discussion. It was found that the consecutive radioisotope technique is very insensitive to epithermal neutron effects. The thermal neutron flux was also determined using the well-known gold activation technique. Flux measurements were made on the same position, using the same irradiation device for both methods. Assuming that the results from gold are correct, the results obtained from the new method are approximately 15% lower. Recommendations for further work include the study of the reasons for this apparently constant factor, epithermal neutron effects and the possible application of the method in the determination of thermal neutron absorption cross sections. (auth)

31864 (WARD-2171-37) FAST FLUX TEST FACILITY QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING MAY 31, 1973. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). 1973. Contract AT(45-1)-2171. 66p. AT.

Research and development activities for the FFTF reactor are reported under the following headings: reactor systems; reactor components; plant systems and instrumentation and control components; plant mechanical components and heat transfer system; safety analysis and review; component testing and material analysis; and project administration. (JWR)

31865 FFTF PROBE-TYPE EDDY-CURRENT FLOWMETER: WET VERSUS DRY PERFORMANCE EVALUATION IN SODIUM. Costello, T. J.; Laubham, R. L.; Miller, W. R.; Smith, C. R. (Westinghouse Electric Corp., Madison, PA). Nucl. Technol.; 19: No. 3, 174-180 (Sep 1973).

An eddy-current flowmeter (ECFM), designed to measure the velocity of coolant sodium exiting the fuel subassemblies of the Fast Flux Test Facility (FFTF), was tested in the Westinghouse Advanced Reactors Division's General Purpose Loop No. 2 (GPL-2) during the period of October 2, 1971 to March 16, 1972. The ECFM was operated in both a wet and dry prototypic (FFTF) design test housing. In the wet design test housing, the ECFM is exposed directly to sodium; in the dry design test housing, the ECFM is shielded from sodium by a stainless-steel "thimble." During both tests, the same ECFM electronics supply and associated wiring were used. The same ECFM electrical adjustments also were employed in both cases. Throughout the total testing period of 1351.6 h, the ECFM operated satisfactorily. No failures or malfunctions occurred in the ECFM, its power supply, or the three test thermocouples. Significantly, the data showed that the ECFM's overall average dc output signal in the dry design was 62% of that in the wet design. (auth)

31866 IN-REACTOR TEMPERATURE MONITOR. Hofman, G. L. (Argonne National Lab., Idaho Falls, ID). Nucl. Technol.; 19: No. 3, 204-206 (Sep 1973).

A passive temperature monitor, based on an indirect determination of vapor pressure of selected elements, was developed for and tested in irradiation experiments in Experimental Breeder Reactor II. The monitor may be used over a wide range of temperatures, and its use is not limited to nuclear applications. (5 references) (auth)

31867 ACOUSTIC DETECTION OF BUBBLE EMISSION IN THE RAPSODIE REACTOR. Bret, A.; Gaillard, M.; Lechel, V. (CEN de Cadarache, Saint-Paul-les-Durance, France). pp 434-453 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). (In French).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The acoustic detection instrumentation of the reactor Rapsodie is described. The results of acoustic measurements obtained during the study of the operational parameters are included. (INIS)

31868 SEFOR OPERATING EXPERIENCE AND SIGNIFICANCE TO LMFBR'S. Arterburn, J. O.; Hikido, K. (General Electric Co., Sunnyvale, CA). pp 510-521 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 2. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The Southwest Experimental Fast Oxide Reactor (SEFOR), having satisfactorily accomplished its objectives of providing safety data and operating experience vital to LMFBR development, was shutdown on January 4, 1972. The test program directed to experimental determination and demonstration of the inherent safety characteristics of the fast spectrum, mixed-oxide fueled, sodium-cooled reactor and in particular, the Doppler coefficient, was completed almost exactly as planned eight years earlier. With the completion of the test program, decommissioning of the SEFOR facility was initiated. The SEFOR project provided a complete experience package conception of the idea to completion of testing, operating, and decommissioning. (INIS)

31869 OPERATING EXPERIENCE WITH RAPSODIE CONCERNING COMPONENT RELIABILITY. Gajac, G. (CEN de Cadarache, Saint-Paul-Durance, France). pp 492-509 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 2. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973) (In French).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Ger. (9 Oct 1972).

31870 NEUTRON FLUX DENSITIES AT THE FORSCHUNGS- UND MESSREAKTOR BRAUNSCHWEIG (FMRB). Alberts, W. G. PTB Mitt.; 83: No. 3, 161-162(1973). (In German).

At the outlets of several beam tubes as well as at various places closer to the reactor core, neutron flux densities in the ranges of thermal and intermediate neutrons have been measured by Au activation probes. The ratio of the flux densities of fast neutrons to thermal neutrons has been determined by means of a U threshold detector in the form of fission fragment track detector. (GE)

Production and Materials Testing and Processing Reactors

Refer also to abstract 31813.

31871 (ORNL-TM-4382) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT, APRIL–JUNE 1973. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 19p. Dep. NTIS $3.00.

Despite eight unscheduled shutdowns the reactor attained an on-stream time of 95.1% during the quarter. The unscheduled shutdowns were all very brief and were caused by instrumentation "noise." Appropriate "tuning" modifications appear to have eliminated the spurious scrams. A routine control plate change was completed at the end of fuel cycle 90 and the control rod guide track bearings were inspected at that time. (auth)

31872 STEELMAKING WITH HEAT FROM THE ATOM. Valery, N. New Sci.; 59: No. 863, 610-615(13 Sep 1973).

A Japanese government agency has recently started a $30 million research and development program aimed at finding out how to make steel using a nuclear reactor instead of a blast furnace. Within six years, it expects to be ready to build the country's first full-scale experimental plant based on a 50 megawatt reactor. The HTR concept has a special attraction for the steelman since the temperature of its circulating helium coolant is at 800°C as it leaves the reactor core in existing reactors and temperatures as high as 1450–1500°C are predicted. This heat can be used to produce the reducing gas to obtain sponge iron and also to heat the gas up to the temperature required in the reduction furnace. Any remaining heat can be converted to electricity. It is considered that steelmaking via the nuclear reactor–sponge iron–arc furnace route already looks cheaper on paper than the conventional blast furnace–basic oxygen process. (UK)

Propulsion and Package Reactors

Refer also to abstracts 30433–30437, and 30511.

31873 (N-72-22664) DESIGN, FABRICATION, AND TESTING OF AN EXTERNAL FUEL (UO_2), FULL-LENGTH THERMIONIC CONVERTER. Final Report. Schock, A.; Raab, B. (Fairchild Industries, Inc., Farmingdale, N. Y. (USA). Republic Div.). 15 Sep 1971. Contract NAS7-100. 166p. (NASA-CR-126142; FHR-3641-A; PCD-TR-71-5). NTIS.

For Jet Propulsion Lab., Pasadena, CA.

The development program includes out-of-pile performance testing of the fully fueled-converter, using rf-induction heating, before its installation in the in-pile test capsule. The external-fuel converter is cylindrical in shape, and consists of an inner, centrally cooled collector, and an outer emitter surrounded by nuclear fuel. The converter is not a scaled-down test device, but a full-scale fuel element of the thermionic reactor. The external-fuel converter concept permits a number of different design options, particularly with respect to the fuel composition and shape, and the collector cooling arrangement. The converter is based on uninsulated collector cooling. The converter is double-ended, with through-flow cooling, and with ceramic seals and emitter and collector power take-offs at both ends. The design uses a revolver-shaped tungsten emitter body, with the central emitter hole surrounded by six peripheral fuel holes loaded with cylindrical UO_2 pellets. (auth)

31874 (N-72-22665) SPACE STATION PROGRAM PHASE B DEFINITION: NUCLEAR REACTOR-POWERED SPACE STATION COST AND SCHEDULES. (North American Rockwell Corp., Downey, Calif. (USA). Space Div.). Jan 1971. Contract NAS9-9953. 286p. (NASA-CR-115547; MSC-744; SD-70-501). NTIS.

Tabulated data are presented on the costs, schedules, and technical characteristics for the space station phases C and D program. The work breakdown structure, schedule data, program ground rules, program costs, cost-estimating rationale, funding schedules, and supporting data are included. (auth)

31875 NUCLEAR SHIPS FOR THE ROUTE TO EASTERN ASIA. Sandscheper, G. VDI (Ver. Deut. Ing.) Nachr.; 27: No. 4, 1-2 (1973). (In German).

The Federal Republic declared its intention at the 4th Atomic Program to follow the only world-wide operated nuclear ship "Otto Hahn" with a demonstration ship. This will mean finding a ship owner as the state is only partly supporting the project. A German–Japanese joint investigation compared the economical aspects of a 80,000-WPS container ship to a marine boiler and reactor. Despite the unfavorable construction data of the nuclear-operated ship, it has long-term advantages in the overall cost as its operating expenses are low. (GE)

31876 PROCESS FOR SAFE LOADING AND UNLOADING OF A MOBILE NUCLEAR REACTOR WITH FUEL ELEMENTS. Vogt, F.; Kostrzewa, S.; Siebert, W. (to Interatom Internationale Atomreaktorbau). German Patent 1,812,088. 11 Jun 1970. Filed date 2 Dec 1968. (In German).

A process is described for loading and unloading in a safe and rapid manner, a mobile nuclear reactor that is liquid cooled. The process is characterized by the fact that a transportable reservoir is used for manipulation. The reservoir which contains a manipulator can be flooded with the nuclear reactor coolant. In the interior of the reservoir magazines are provided for new and used fuel elements. The floor is made in such a manner that one can store a closed container for the fuel elements. (TSS)

Reactor Safety and Environmental Aspects

Refer also to abstracts 29832–29834, 29836, 29910, 29911, 30125, 31837, 31954, and 32104.

31877 (CONF-720823-P1, pp 144-158) ACCIDENT ANALYSIS FOR LMFBR ENGINEERED SAFEGUARDS DESIGN. Silberberg, M.; Koontz, R.; Baurmash, L.; Johnson, R. P. (Atomics International, Canoga Park, CA). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

The release and control of radioactive material which becomes airborne as a result of the Hypothetical Core Disruptive Accident (HCDA) and sodium fires can be properly evaluated by a system of Codes (SOFAACS) developed for the Liquid Metal Fast Breeder Reactor (LMFBR) by Atomics International. These codes, and the applications of their use for LMFBR safety analysis and engineered safeguards design, are summarized. The codes include SOFIRE II, HAA-3, and SODROP models, which compute, respectively, sodium burning rate and heat transfer from open pool fires, burning and heat transfer controlled by convection through openings in partitions, behavior of the sodium oxide, fuel, and fission product aerosols, including agglomeration and settling, and sodium burning and energy release rates from sodium dispersed into inerted cells or air containment. Use of these codes, in conjunction with required data from model experiments and scaling considerations, allows a realistic assessment of: (1) the design bases and requirements for engineered safeguards for meeting reactor siting criteria, and (2) the need for air cleaning systems during sodium fires for reducing postaccident cleanup. 9 references. (auth)

31878 (CONF-720823-P1, pp 207-218) EFFECTIVENESS OF FISSION PRODUCT REMOVAL SYSTEMS IN PWR CONTAINMENTS. Pasedag, W. F. (Westinghouse Electric Corp., Pittsburgh). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

In order to apply the body of information concerning individual fission product removal processes to the design of engineered safety systems for a full-sized reactor application it is necessary to evaluate the simultaneous performance of these systems in the loss-of-coolant accident environment. A time-dependent, multi-

volume model of the containment, which incorporates mathematical models of all significant transport and removal processes, is used for this analysis. The off-site iodine inhalation doses obtained from this model are used as a criterion for comparison of the iodine removal effectiveness of the various systems. A comparison of the results obtained from this analysis with the results of the traditional dose reduction factor concept shows that the integrated approach of this analysis is a more conservative method of the evaluation of safeguards systems. 10 references. (auth)

31879 (RDT-INDEX-7-73) INDEX OF RDT STANDARDS. (Division of Reactor Research and Development (AEC), Washington, D. C.). Jul 1973. 34p. RSO.

31880 (RDT-INDEX-9-73) INDEX OF RDT STANDARDS. (Division of Reactor Research and Development (AEC), Washington, D. C.). Sep 1973. 39p. RSO.

31881 (TRG-Report-2450) COMPARISON OF THE PRESSURE EFFECT OF ENERGY RELEASE FROM NUCLEAR EXCURSIONS AND CHEMICAL SIMULATIONS. Cowler, M. S.; Hoskin, N. E. (Atomic Weapons Research Establishment, Aldermaston (England)). Jul 1973. 12p. (GRO-44/91/30; CONF-721006-8). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

An attempt is made to compare the energy release or damage potential resulting from sodium–UO_2 interactions in fast reactor vessels and explosive charge simulations. The results indicate that a low density explosive charge is preferable to a high energy charge for simulation experiments. (JWR)

31882 SEISMIC CONSIDERATIONS IN SITING AND DESIGN OF POWER PLANTS. Matthiesen, R. B. (Seismological Field Survey, San Francisco); Howard, G.; Smith, C. B. Nucl. Eng. Des.; 25: No. 1, 3-16(1973).

A methodology which provides guidelines for the preliminary evaluation of the safety of fossil-fueled and nuclear power stations subjected to strong vibratory ground motions from earthquakes is outlined. The methodology includes a procedure for estimating a spectral envelope of ground motion at the reactor site. On the basis of this ground motion the seismic response of structural systems and equipment of the power plant can be estimated. A comparison of the expected seismic response of these systems with their strength and functional capabilities yields an evaluation of the safety of the power plant systems studied. (10 figures, 28 references) (auth)

31883 VIBRATION TESTING OF FULL-SCALE STRUCTURES. Smith, C. B. (Applied Nucleonics Co. Inc., Los Angeles); Matthiesen, R. B. Nucl. Eng. Des.; 25: No. 1, 17-29(1973).

Vibration testing of nuclear reactor plant systems is discussed as a part of the determination of the response of such systems to earthquakes. The methods of ambient, harmonic excitation, and impulse testing are compared. Harmonic excitation tests provide a method of obtaining the complete dynamic characteristics of a system and of selectively studying each of the components of the system, e.g. containment, pressure vessel, steam generator. Generally, both ambient and impulse testing studies do not provide as much detailed information. Problems in interpreting test results are discussed, in particular the problems of differing frequency spectrum excitation level of the exciting force from strong-motion earthquakes and extrapolation of responses in the presence of nonlinearities in the system behavior. The equipment, performance, and evaluation of steady-state forced vibration tests and of impulse tests by detonating explosives are described. (10 figures) (auth)

31884 IDENTIFICATION OF DYNAMIC PARAMETERS OF LINEAR AND NON-LINEAR STRUCTURAL MODELS FROM EXPERIMENTAL DATA. Ibanez, P. (Applied Nucleonics Co. Inc., Los Angeles). Nucl. Eng. Des.; 25: No. 1, 30-41(1973).

Recent and new approaches to the identification of dynamic properties such as damping, eigenfrequencies, mode shapes, and nonlinear effects are described. Special attention is paid to the philosophical and practical aspects of identifying such eigenparameters, as others have done much work in the adjustment of mass and stiffness parameters to reproduce these eigenparameters (once they are found). Application to an actual structure is discussed in an attempt to illustrate the effectiveness of the method and familiarize the reader with the type of problems encountered. A summary of typical procedures for vibration testing and parameter identification is presented. (10 figures) (auth)

31885 SOME INVESTIGATIONS ON NON-LINEAR DYNAMIC RESPONSE OF NUCLEAR POWER SYSTEMS TO GROUND MOTIONS. Howard, G. E. (Applied Nucleonics Co. Inc., Los Angeles). Nucl. Eng. Des.; 25: No. 1, 42-50(1973).

An investigation of the significance of nonlinear behavior in the seismic response of the experimental gas-cooled reactor (EGCR) facility was performed using explosive impulses and "snapback" tests. The study focuses on soil-structure interaction effects and nonlinear characteristics of containment building and steam generator responses. Comparison of the result of these at large excitation levels (corresponding to large earthquakes) with the results of earlier steady-state low-level vibration tests shows marked departures from response predicted by conventional linear modeling. Results illustrate the significant nonconservative errors possible when using linear theory to predict large amplitude responses of systems exhibiting nonlinear behavior. (10 figures, 24 references) (auth)

31886 FORCED VIBRATION TESTS AND ANALYSES OF NUCLEAR POWER PLANTS. Hornbuckle, J. (Southern California Edison Co., Roseread); Mercurio, T.; Howard, G.; Ibanez, P.; Smith, C. B.; Vasudevan, R.; Matthiesen, R. B. Nucl. Eng. Des.; 25: No. 1, 51-93(1973).

Methods for conservatively predicting the response of a constructed nuclear power plant to earthquake excitations are presented. This approach is based on experimental testing of the reactor plant and using test results to develop a mathematical model of the system. First, steady-state forced vibration tests are conducted using structural vibrators attached to the reactor structure to determine dynamic response characteristics. Second, modal analysis applied on a digital computer is used to create a linear multiple-degree-of-freedom model that has dynamic response characteristics nearly the same as the physical system for the experimental inputs. Finally, the input force levels are extrapolated from the levels of the inertial vibrators to earthquake levels and the response of the model is calculated for strong-motion earthquakes. Tests have been conducted on three nuclear power plants: the experimental gas-cooled reactor (EGCR) at Oak Ridge, Tennessee; the Carolinas-Virginia tube reactor (CVTR) at Parr, South Carolinia; and the San Onofre Nuclear Generating Station (SONGS), San Onofre, California. Analyses in varying detail have been performed; the most extensive work has been done at San Onofre. This article summarizes test results, dynamic models, and the results of seismic response calculations for each plant. (43 figures, 17 tables, 48 references) (auth)

31887 FORCED VIBRATION TESTS ON ELECTRICAL DISTRIBUTION EQUIPMENT. Ibanez, P.; Spencer, R. B.; Smith, C. B. (Applied Nucleonics Co. Inc., Los Angeles). Nucl. Eng. Des.; 25: No. 1, 94-111(1973).

Tests and seismic analyses performed on electrical distribution equipment of various types are described. Forced vibration testing was carried out by mounting a sinusoidal steady-state eccentric mass vibration exciter (shaker) on the structure to be tested. The response of various points on the structure was measured by accelerometers as the frequency of excitation slowly changed in incremental steps. The object of the forced vibration testing and subsequent analysis was to identify the seismically important modes of vibration: their mode shapes, eigenfrequencies, and dampings. Once identified, these parameters can be used to predict the response of the tested system to a variety of earthquake inputs. The vibration testing of electrical distribution equipment has yielded useful information about its dynamic response. Such information is useful in redesign of existing equipment to meet modern earthquake resistance criteria and in guiding the design of new equipment. (18 figures, 9 tables) (auth)

31888 EXPERIMENTAL DETERMINATION OF DAMPING IN NUCLEAR POWER PLANT STRUCTURES AND EQUIPMENT. Hart, G. C. (Univ. of California, Los Angeles); Ibanez, P. Nucl. Eng. Des.; 25: No. 1, 112-125(1973).

A summary of damping values for structures and equipment obtained in several full-scale dynamic tests performed on a research reactor, three experimental power reactor plants, and a commercial power reactor plant is given. The testing techniques used include steady state shakers, dynamite blasting, and snapback. Guidelines are presented for required frequency resolution and record length for damping estimation from blast or snapback records. The influence of system nonlinearity upon damping interpretations is also discussed. (7 figures, 9 references) (auth)

31889 SIMULATION OF STRONG MOTION EARTHQUAKE EFFECTS ON STRUCTURES USING EXPLOSIVE BLASTS. Bleiweis, P. B. (Univ. of California, Los Angeles); Hart, G. C.; Smith, C. B.; Matthiesen, R. B. Nucl. Eng. Des.; 25: No. 1, 126-149(1973).

Results are presented of three separate test programs which were conducted to determine the feasibility of simulating strong-

motion earthquake effects using dynamite blasting techniques. The three programs measured blast induced structural responses at: (1) the UCLA Field Station; (2) the Enrico Fermi Nuclear Power Plant, Monroe, Michigan; and (3) EGCR at ORNL. Evaluation of the tests indicates that the simulation of strong earthquake excitations using subsurface blasting techniques is a valuable testing tool. Each of the three discussed tests indicates that reliable estimates of natural frequencies and mode shapes of vibration can be obtained directly. (35 figures, 8 tables, 9 references) (auth)

31890 COMPARISON OF EXPERIMENTAL METHODS FOR SEISMIC TESTING OF EQUIPMENT. Ibanez, P.; Vasudevan, R.; Vineberg, E. J. (Applied Nucleonics Co. Inc., Los Angeles). Nucl. Eng. Des.; 25: No. 1, 150-162(1973).

Mathematical models of various types of electrical distribution equipment are generated from the results of forced vibration tests. The models are then subjected to four types of base motion input: digitized historical earthquakes, computer-generated artificial earthquakes, sine beats, and steady state sines. The responses of the various models to the different types of base motion inputs are presented and statistically analyzed. Aside from slight difference in the scattering of results and difference in the maximum response obtained which can be corrected using appropriate scaling factors, the results obtained using the earthquake-like base motion are found to be in fairly close agreement. With regard to sine beat and steady state sine testing, certain problems arise which must be considered if this type of analysis is to be substituted for analysis involving earthquake-like base motion. (14 figures, 5 tables, 11 references) (auth)

31891 SHIPPINGPORT: THE KILLER REACTOR. Lewis, R. New Sci.; 59: No. 862, 552-553(6 Sep 1973).

A report is given of a fact finding committee of doctors and scientists which is inquiring into charges that radioactive emissions from the 90 megawatt nuclear power station of the Duquesne Light Co. at Shippingport, Pa. have resulted in a sharp rise in infant mortality and cancer deaths in adjacent areas of western Pennsylvania and eastern Ohio. (UK)

31892 ENVIRONMENT AND NUCLEAR REACTORS. Ertaud, A. (Groupement Atomique Alsacienne Atlantique, Les Plessis-Robinson, France). Usine Nouv., Supp.; 93-100(Jun 1972). (In French).

The nuclear industry has succeeded in constructing installations which are safer and present smaller pollution problems than other industries. Very slight modifications to nuclear plants can minimize the formation of radioactive effluents in boiling water or pressurized water reactors and improve the reprocessing of irradiated fuels with only a small increase in cost. The consequences of an accidental release of some of the radioactivity stored in a reactor are envisaged and appropriate protection systems have been developed. Problems connected with thermal pollution of nuclear or other origin are considered. (FR)

31893 EFFECT OF NONCONDENSABLES ON THE RATE OF SODIUM VAPOR CONDENSATION FROM SINGLE-RISING HCDA BUBBLE. Theofanous, T. G.; Fauske, H. K. (Argonne National Lab., IL). Nucl. Technol.; 19: No. 3, 132-139(Sep 1973).

In considering the process of liquid-metal vapor condensation during the rise of a large vapor bubble in a pool of cool liquid, previous studies have ignored the effect of the noncondensables. By solving the problem of transient mass diffusion in the vapor space in conjunction with the problem of transient heat conduction and convection in the liquid phase, the effect of noncondensables has been shown to seriously retard the condensation process. (8 references) (auth)

31894 NUCLEAR POWERED ENERGY CONVERSION SYSTEM. Lindsley, T. US Patent 3,755,076. 28 Aug 1973. Filed date 3 Dec 1971. 4p.

An energy recovery system employing a remotely positioned underground nuclear generator and associated heat and hydrodynamic conversion means is described. The depth is sufficient to protect against radiation or explosion. Water from the ground level is used to power a hydroelectric generator and is then fed to the boiler heated by the reactor. (3 claims, 1 drawing figure) (Official Gazette)

31895 SOME ASPECTS OF SAFETY PROBLEMS AND THEIR SOLUTIONS CONCERNING A FAST NEUTRON POWER REACTOR. Argous, J. P. (CEN de Cadarache, Saint-Paul-les-Durance, France); Puig, I.; Chalot, A. Bull. Inform. Sci. Tech. (Paris); No. 182, 85-90(Jun 1973). (In French).

Specific features and risks in sodium cooled fast neutron reactors are considered for safety studies. Some items concerning the analysis of the core behavior are given for some accidents. (FR)

31896 SAFETY SYSTEM FOR GAS-COOLED CYCLE INSTALLATIONS LOCATED ON THE EXTERIOR OF A REACTOR PRESSURE VESSEL. Schoning, J. (to Brown Boveri Krupp Reaktorbau GmbH). German Patent 1,539,726. 4 Jun 1970. Filed date 9 Dec 1966. (In German).

Safety systems for gas-cooled installations are located on the exterior of a nuclear reactor pressure vessel where the total volume of the installation is divided into partial volumes that are approximately equal and are connected to each other by tubes. The system is characterized by the fact that there are safety devices, in case of rupture of a tube, integrated in such a fashion in the tubes that at the time of a leak the part concerned is blocked with respect to the other parts. (TSS)

31897 SITES FOR NUCLEAR POWER PLANTS. Guck, R. (Badenwek AG, Karlsruhe, Ger.). Atomwirt., Atomtech.; 18: No. 8-9, 386-391(1973). (In German).

In the next few years sites will be required in the German Federal Republic for power stations, conventional and nuclear, whose choice will lead to greater problems with the present population density. This is particularly true in overcrowded industrial areas which form the centers for use of electrical energy. The fixing of sites for nuclear stations of large capacity is closely connected with power station and distribution network planning and also with a sensible layout resulting from planning measures of the Lands and Central Government. As far as energy policy as a whole is concerned, and this must include site planning, it is permeated today in addition to the energy economy aspects by increasing political factors which cannot but influence the electrical power industry. (GE)

31898 REACTOR SAFETY: DUTIES FOR THE STATE. Sahl, W. (Bundesminisiterium des Innern, Bonn). Atomwirt., Atomtech.; 18: No. 8-9, 391-393(1973). (In German).

When the new German Federal Government was formed in the autumn of 1972 the advancement of nuclear energy was transferred to the new Federal Minister for Research and Technology but the responsibility for reactor safety lies with the Federal Minister of the Interior. This should avoid such possible conflicts between the research and monitoring of nuclear energy as might arise if both responsibilities were in the hands of one Minister. This appears particularly important for the future when the increasing numbers of nuclear power stations will make it essential to take more strongly into account not only the safety of the individual stations but also the total risk stemming from them all. (GE)

31899 ZOOLOGICAL GARDENS NEXT TO A NUCLEAR POWER PLANT. Harmlessness Is to Be Proven. Foltin, B. Handelsblatt; 28: No. 46, 20(1973). (In German).

When the plans to build a new necessary nuclear power plant in the Federal Republic become known, a heated controversial discussion immediately follows on the supposed dangers of such power plants to humans and environment, on the site, order of dimension and basic necessities of such plants. The arising and course of these nuclear controversial quarrels are tackled as individual arguments and the lack of scientific knowledge is shown. (GE)

Reactor Theory and Calculation

Refer also to abstracts 31294, 31295, 31432, 31820, and 31857.

31900 (AD-756569) STABILITY ANALYSIS OF NUCLEAR REACTORS USING LIAPUNOV'S SECOND METHOD. D'Alessio-Ipinza, F. A. (Naval Postgraduate School, Monterey, Calif.). Dec 1972. 87p. NTIS.

Thesis.

Any change in neutronic properties in a reactor operating at steady state will result in a change in the equilibrium neutron flux and hence, the power of the reactor. A main cause for a change in neutronic properties is the high temperature attained in a reactor, which produces a feedback in the reactor operation. The response of the reactor to a particular feedback is analyzed by using Liapunov's Second Method to specify stability regimes. Both the point-kinetics model and the distributed parameters system are analyzed. Data from typical thermal and fast reactors is used to specifically determine the stability domains. (auth)

31901 (NIIAR-7206-P-148) PIDIR: THE CODE OF ONE-DIMENSIONAL DIFFUSION MULTIGROUP REACTOR CALCULATION. Zamel'tdinov, R. I. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 34p. (In Russian). INIS.

31902 (RT/FI-(73)14) SENSITIVITY COEFFICIENTS CALCULATION USING DIRECT AND GENERALIZED PERTURBATION METHODS. Boeriu, S.; Cecchini, G. P. (Comitato Nazionale

per l'Energia Nucleare, Rome (Italy)). 6 Apr 1973. 21p. Dep. NTIS (U.S. Sales Only) $3.25.

Results are presented of a comparison between the sensitivity coefficients calculated by generalized perturbation techniques and by direct methods, both for zero and one-dimensional models. (auth)

31903 (RT/FI-(73)15) A 26-GROUP LIBRARY WITH SELF-SHIELDING FACTORS FOR FAST REACTOR CALCULATIONS FROM THE UK NUCLEAR DATA FILE. Menapace, E.; Motta, M.; Panini, G. C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 9 Apr 1973. 48p. Dep. NTIS (U.S. Sales Only) $4.50.

A 26-group cross sections and self-shielding factors library set in the ABBN Russian scheme is presented. The work has been performed assuming as a primary source of microscopic data the UKNDL and ENDF/B-II data collections as released during 1971. (auth)

31904 SENSITIVITY OF THE PROMPT DOPPLER FEEDBACK OF THERMAL REACTORS TO THE POWER DISTRIBUTION. Ostensen, R. W. Urbana, IL; Univ. of Illinois (1973). 94p. University Microfilms Order No. 73-17,613.

Thesis (Ph. D.).

An analytic and computational study of one type of temperature feedback in commercial nuclear reactors is presented. The minimum and maximum values of the prompt Doppler feedback and the corresponding power distributions in the reactor core are found subject to a set of engineering constraints. First order perturbation theory is used to derive a functional for the Doppler feedback. This functional is dependent on the power, neutron flux, adjoint flux and fuel distributions in the reactor core. A general computer program was written to solve for the extremal points of this type of functional using methods from optimal control theory. It is shown that the minimum problem does not have a physical solution. A method using generalized functions was developed to handle this problem. The Doppler feedback was found to be only weakly dependent on the power distribution. Feedback shifts of less than 20% may be expected from fuel burnup or design changes. (Diss. Abstr. Int., B)

31905 PROPOSAL FOR A NEW METHOD OF MEASURING THE DECAY HEAT OF FISSION PRODUCTS THROUGH NOISE ANALYSIS OF GAMMA RAYS. Saito, K. (Hokkaido Univ., Sapporo). Nippon Genshiryoku Gakkaishi; 15: No. 5, 338-347 (May 1973). (In Japanese).

High power operation of nuclear reactors depletes the nuclear fuel and accumulates fission products (F.P.'s) in the fuel. Almost all the F. P.'s are unstable and emit γ and/or β in the course of their transmutation. Their total energy varies depending on the fuel depletion and on the time elapsed after the production of the F. P.'s. When the power reactors are shut down, the decay heat plays the role of heat source, the emission rate of which has however not a deterministic but rather a stochastic nature. The fluctuating heat source gives rise to fluctuations in the temperature of the core material. When the dirty core is restarted and operated at relatively low power level, the fluctuations in neutrons, and in the high-energy photons emitted upon nuclear fission, as well as the temperature noise are caused primarily by the fluctuations in the decay heat. There is a possibility of obtaining some information on the magnitude of the decay heat through noise analysis of the high-energy photons or of the temperature. The present paper examines theoretically the stochastic nature of the decay heat and its relation to the fluctuations in temperature, neutrons and prompt gammas. It should be of interest to perform experiments with use made of the present new method of determining the decay heat and/or the in-core fuel depletion. (auth)

31906 REACTOR PHYSICS AS AN ESTABLISHED ENGINEERING SCIENCE AND ITS ROLE IN REACTOR CONSTRUCTION. Boehm, W. (Siemens, AG, Erlangen, Ger.); Harder, H.; Henssen, H.; Kilian, P. Atomwirt., Atomtech.; 18: No. 8-9, 421-426(1973). (In German).

Based on classical neutron physics the necessary and remaining functions of reactor physics in the construction of nuclear power plants are highlighted. Its most important aid is the computer for calculations of the macroscopic behavior of complicated systems with sufficient accuracy from the knowledge of atomic constants and geometric data. Examples: spatial heat distribution within the core, control and failure behavior, reactivity control, fuel demand planning, shielding, optimization and parameter studies. (GE)

Reactor Components and Accessories

Refer also to abstracts 29787, 29788, 30429, 30562, 30565–30567, and 30647.

31907 (CONF-720823-P1, pp 60-70) EFFECT OF RUPTURE IN A FISSION GAS HOLDUP BED. Underhill, D. W. (Harvard School of Public Health, Boston). Jan 1973.

From 12th AEC air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

In proceedings of the twelfth AEC air cleaning conference.

A gas adsorption bed operated under pressure will lose a portion of the adsorbed gases in the event of an accidental rupture of the container and release of pressure. Theoretical and laboratory studies show that the fractional release of fission gases will be smaller than the ratio of the initial to the final bed pressure and that the fraction of krypton released will be greater than the fraction of xenon released under the same conditions. (auth)

31908 (ORNL-4870, pp 59-62) HEAVY SECTION STEEL TECHNOLOGY. Canonico, D. A. Oct 1973.

In Metals and Ceramics Division annual progress report for period ending June 30, 1973.

Tensile properties, toughness, and crack propagation were studied for representative sections of intermediate-size pressure vessels and pipe. An extensive study of neutron-induced changes in impact and tensile properties of thick plate and weldments was completed and reported. A thorough search found no evidence of cracking in submerged-arc welds in 6-in.-thick forgings and plates. In an intentionally flawed pressure vessel pressurized to destruction, the longitudinal split showed ductile tearing near the initial flaw, changing to a cleavage mode of fracture. (auth)

31909 (RDT-E-8-12-T(7-73)) VISUAL IN-SERVICE INSPECTION SYSTEM AND ASSOCIATED EQUIPMENT FOR THE REACTOR ENCLOSURE SYSTEM. (Division of Reactor Research and Development (AEC), Washington, D.C.). Jul 1973. 23p. RSO.

Requirements for development, design, performance, fabrication, inspection, testing, cleaning, packaging, delivery, and field engineering for visual inservice inspection systems and associated equipment for the reactor vessels are established. Visual inservice inspection systems include closed circuit television cameras, trolleys, monitors, video tape recorders and reels, cables, take up reels, electronic control equipment, and insertion plugs. (FS)

31910 TECHNICAL APPLICATION OF FRACTURE MECHANICS TO THE SAFETY ANALYSIS OF NUCLEAR REACTOR PRESSURE VESSELS. Bartholome, G. (Siemens AG, Erlangen, Ger.). (1973). vp. (In German).

From third international congress on fracture; Munich, Germany (8 Apr 1973).

The transition temperature approach and the fracture mechanics concept are used to ensure the safety against brittle fracture. An example for the fracture mechanics concept is given. For design purposes the undercritical crack length for ductile failure and the leakage area of this crack is calculated. The concept of fracture mechanics also is used in the ASME-Code. The protection against nonductile failure for nuclear reactor components is based on the assumption of a conservative crack depth and on the use of a safety factor of two on the membrane stress intensity factor. The application of these ASME-Code criteria is shown for a nuclear reactor pressure vessel. (GE)

31911 SYSTEMS APPROACH TO THE AVOIDANCE OF BRITTLE FRACTURE IN PRESSURE VESSELS. Varga, T. (Sulzer Brothers Ltd., Winterthur, Switzerland). (1973). vp.

From third international congress on fracture; Munich, Germany (8 Apr 1973).

Under the assumption that the components have been dimensioned and fabricated so that no yielding occurs in the overall cross section under loading in the proximity of the biggest possible defect located anywhere, questions relating to the fracture safety under static loading are examined. Any stress peaks exceeding the locally applicable yield strength are reduced by plastic deformation as long as adequate ductility is assured. (GE)

31912 INVESTIGATION OF THE FATIGUE STRENGTH OF HIGH-STRENGTH BOLTS FOR NUCLEAR REACTOR PRESSURE VESSELS. Kristof, H.; Klausnitzer, E. (Kraftwerk Union AG, Erlangen, Ger.). (1973). vp. (In German).

From third international congress on fracture; Munich, Germany (8 Apr 1973).

Specimens of the two steel types SAE 4340 and 25NiCrMo145, which represent steels for bolts of reactor pressure vessels, were examined in a low cycle fatigue test. The test strains simulate the strains in the root of the thread. Test temperatures: from 20 to 330°C. The results (number of cycles till a fatigue crack starts) show a slightly higher fatigue resistance of the 25NiCrMo145. (GE)

31913 FRACTURE MECHANICS ANALYSIS OF CRACK GROWTH IN CLADDED REACTOR COMPONENTS. Neubrech, G. (Siemens AG, Erlangen, Ger.). (1973). vp.

From third international congress on fracture; Munich, Germany (8 Apr 1973).

A method of fixing an upper and lower limit of crack growth in a simple component of stainless steel is described. An attempt is made to define as closely as possible the real behavior of flaws on the basis of more accurate estimates. (GE)

31914 GUIDE FOR TYPE TEST OF CLASS 1E ELECTRIC CABLES. Field Splices and Connections for Nuclear Power Generating Stations. New York; Institute of Electrical and Electronic Engineers (1973). 9p. (ANSI-N41.10).

31915 ULTRASONIC SYSTEM FOR MONITORING VIBRATIONS IN A NUCLEAR REACTOR. Scott, C. C.; Lagowski, J. P. US Patent 3,753,852. 21 Aug 1973. Filed date 10 Dec 1971. 6p.

An apparatus is designed for detecting the frequency and amplitude of vibration of a preselected vibrating member inside a nuclear reactor vessel from an external point including a transducer mounted on the outside of the vessel for transmitting a signal to said member and receiving an echo back from the vibrating member, a pulse generator for generating repetitive pulses, a high-frequency oscillator triggered by the pulse generator, the transducer being excited by the high-frequency pulses for transmitting the signal, a delay circuit having a time delay equivalent to the time interval for ultrasonic pulses travelling between the transducer and the operating member, a phase detector, a gate circuit synchronized with the pulse generator for feeding the delayed transmitting pulses and the corresponding receiving echoes simultaneously to the phase detector, and read-out means for the frequency and amplitude of vibration of the vibrating member. (Official Gazette)

31916 PROCESS FOR SEPARATING GAS BUBBLES FROM THE COOLANT STREAM OF A FLUID-COOLED NUCLEAR REACTOR. Markfort, D.; Kaiser, A. (to Interatom Internationale Atomreaktorbau). German Patent 1,815,047. 25 Jun 1970. Filed date 17 Dec 1968. (In German).

Processes are described for the separation of bubbles produced in the coolant of a nuclear reactor cooled by a liquid and removal of the gas bubbles from the center of the reactor core is characterized by the fact that the cooling agent introduced into the lower part of the reactor vessel flows in forced circulation in the form of a screw and is directed toward the bottom. The current is deflected radially to the lowest point and passes through the center of the reactor core where the gas bubbles collect above the flow of coolant products and are then eliminated. (TSS)

31917 PRESTRESSED PRESSURE VESSEL FOR A NUCLEAR REACTOR. Ritz, L. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,684,699. 27 Aug 1970. Filed date 18 Jul 1967. (In German).

A pressure vessel of prestressed concrete for a nuclear reactor, especially for a water-cooled fast reactor, where the steam generator or the heat exchanger with the pumps and pipes for the coolant are outside the reactor core is characterized by the fact that the pressure vessel is made as a body of concrete homogeneous with the reactor core with openings that can be blocked. (TSS)

31918 NUCLEAR REACTOR. Broughton, K. J. (to Atomic Power Construction Ltd.). German Patent 1,915,562. 8 Oct 1970. Filed date 27 Mar 1969. (In German).

A nuclear reactor containing a certain number of routes for charging serving as access to the channels that are located in the core of elements of the core and a transport apparatus for core elements along the tracks for charging to bring them into or out from the channels is described. This reactor is characterized by the fact that the core elements contain, in the neighborhood of their extremity which penetrates first into the core, a joint to prevent the coolant from flowing out from the upper surface of the core element. (TSS)

31919 PHOTOGRAPHIC AND TELEVISION TECHNIQUES FOR NUCLEAR REACTOR MONITORING. Arch. Energiewirt.; 27: No. 15, 747-753(1973). (In German).

The careful periodic control of the inner surfaces of nuclear reactor casings, of circuits and piping is becoming increasingly important; for this control modern methods in optics, photography and television techniques are used which are especially designed for work in radiation contaminated environment. A short survey is given on the present national and foreign equipment on the market. (GE)

31920 RELIABILITY CONTROL IN REACTOR CONSTRUCTION. Zeibig, H. (Internationale Atomreaktorbau, Bensberg, Ger.). Atomwirt., Atomtech.; 18: No. 8-9, 400-406(1973). (In German).

From reactor meeting; Karlsruhe, Germany (10 Apr 1973).

In reactor technology quantitative evidence must be produced demonstrating safe operation of the system over a time span of about 30 years. Practical results so far obtained show that an effective system control can be achieved by reliability techniques. The reliability computer program must take full account of the maintainability and inspectability aspects of the system. The difficulties which formerly arose in demonstrating very small breakdown probabilities have now been surmounted. (GE)

31921 PWR CONTAINMENT DESIGN CONSIDERATIONS. Haseltine, J. D. (Yankee Electric Co., Boston). Power Eng.; 77: No. 10, 44-47(Oct 1973).

The large containment structure for a pressurized water reactor is designed to contain the energy released from a postulated rupture of the reactor coolant system, natural disasters, and airplane crashes. The design considerations include adequate room for personnel access, in-service inspection, operations, and maintenance. The general layouts discussed include descriptions of the containment and gantry cranes, access hatches, and the refueling layouts. (MCW)

Reactor Fuels

Refer also to abstracts 29615, 29782, 29783, 30424, 30426, 30427, 30430, 30433-30438, 30441, 30442, 30446, 30480, 30501, 30512, and 30513.

31922 (AERE-R-7380) FRUMP: A COMPUTER PROGRAMME FOR THE CALCULATION OF STRESSES IN REACTOR FUEL PINS. Hayns, M. R.; Wilmore, D. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1973. 69p. Dep. NTIS (U.S. Sales Only) $5.50. UK £ 1.50.

A new mathematical model, for the calculation of the elastic and plastic strains due to thermal stresses, has been developed. The technique used to linearize the equations introduces errors which are smaller than those already inherent in using a numerical method. Its advantages are apparent in the stability of the solution, and the speed and accuracy of computation. The computer program using this method includes facilities for the inclusion of swelling, thermal and irradiation creep and any parameterization of these effects can be easily included. Calculations using a schematic fuel pin system are described to show the detailed information which can be obtained. These results show that the program is capable of operating with sufficient speed, detail and accuracy, and that reliable calculations of the conditions over many power cycles, or for very fast transients, are easily within its capabilities. (auth)

31923 (BMFT-FB-K-73-06) INFLUENCE OF THE STANDARDIZATION OF FUEL ELEMENTS ON THE SAFETY AND ECONOMICS OF NUCLEAR POWER STATIONS. Rittig, D. (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (West Germany)). Apr 1973. 58p. (In German). INIS.

The fuel elements of the various types of reactors have achieved a certain perfection, based, of course, on current standards of technology. The immediate future will not show an economical advantage for such fuel elements, unless money is put into development. Standardization is considered as a subsequent stage of the development of a proven system. Based on the current market trend, it is assumed that 90% of the nuclear power plants commissioned between 1978 and 1984 will be powered by light-water reactors, 60% as pressurized reactors and 40% as boiling water reactors. Standardized fuel elements are used throughout the life of the reactors. It is shown that in order to cover the demand for fuel elements, several cheap-to-run manufacturing sources are necessary. Because of the repeated manufacture of the unchanged products, their manufacture is subject to a definite "learning process". The economic effects of this learning process on the manufacturing costs of the fuel elements, fuel cycle, and power are demonstrated. The resulting saving in costs during the whole service period of the reactors having standardized fuel elements is indicated. Considering the fact that no specific investments are necessary, the saving is considerable. A final chapter indicates the problems of fuel element manufacture and testing, in order to show that the "learning process" has in fact a real background. (GE)

31924 (WCAP-4167-4) EEI: WESTINGHOUSE PLUTONIUM RECYCLE DEMONSTRATION PROGRAM. Progress Report, October 1971-March 1972. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). Dec 1972. Contract AT(30-1)-4167. 27p. Dep. NTIS $3.50.

Research progress in the Plutonium Recycle Demonstration Program during the period is reported. The operation performance of demonstration mixed oxide assemblies in the San Onofre Reactor is described. (JWR)

31925 NUCLEAR REACTOR FUEL ELEMENT SPACER ASSEMBLY. Iwao, K. R.; Yee, D. (to Continental Oil Co.). US Patent 3,746,617. 17 Jul 1973. Filed date 1 Jun 1970. 8p.

A reactor fuel element spacer arrangement is designed having fuel-rod supporting and spacing means in the form of resilient slotted spacer tubes mounted on tie rods or bars secured to a supporting sleeve. The spaces between the spacer tubes are such that the fuel elements are gripped between adjacent spacer tubes or between spacer tubes and portions of the sleeve. The arrangement facilitates loading of the fuel elements and minimizes scratching of the fuel elements. (5 figures) (Official Gazette)

31926 NUCLEAR REACTOR FUEL ELEMENT SPACER ASSEMBLY. Nakazato, S. (to Continental Oil Co.). US Patent 3,746,618. 17 Jul 1973. Filed date 1 Jun 1970. 6p.

A reactor fuel element spacer arrangement is described having a fuel element supporting and spacing means in the form of spacer tubes mounted on tie rods or bars secured to a resilient supporting sleeve with the tie rods in tension. The spaces between the spacer tubes are such that the fuel elements are gripped between adjacent spacer tubes or between spacer tubes and portions of the sleeve. The arrangement facilitates loading of the fuel elements and minimizes scratching of the fuel elements. (7 figures) (Official Gazette)

31927 NUCLEAR REACTOR FUEL ELEMENT SPACER ASSEMBLY. Iwao, K. R. (to Continental Oil Co.). US Patent 3,746,619. 17 Jul 1973. Filed date 1 Jun 1970. 4p.

A nuclear reactor fuel element spacer arrangement is described having a fuel rod supporting and spacing means in the form of individual cells through which respective fuel rods extend. The cells have a number of sides, some of which are provided with leaf spring members protruding above and below the cell and others of which are provided with knobs such that the fuel rod in each cell is resiliently gripped between the springs and the knobs in a manner to restrict lateral motion of the fuel rods. (Official Gazette)

31928 NONDESTRUCTIVE ANALYSIS OF FUEL PINS. Stepan, I. E.; Allard, N. F.; Suter, C. R. (to United States Atomic Energy Commission). U. S. Patent 3,755,675. 28 Aug 1973. Filed date 3 Nov 1972. 8p.

A method and a correspondingly adapted facility are described for the nondestructive analysis of the concentration of fuel and poison in a nuclear reactor fuel pin. The concentrations of fuel and poison in successive sections along the entire length of the fuel pin are determined by measuring the reactivity of a thermal reactor as each successive small section of the fuel pin is exposed to the neutron flux of the reactor core and comparing the measured reactivity with the reactivities measured for standard fuel pins having various known concentrations. Only a small section of the length of the fuel pin is exposed to the neutron flux at any one time while the remainder of the fuel pin is shielded from the neutron flux. In order to expose only a small section at any one time, a boron-10-lined dry traverse tube is passed through the test region within the core of a low-power thermal nuclear reactor which has a very high fuel sensitivity. A narrow window in the boron-10 lining is positioned at the core center line. The fuel pins are then systematically traversed through the tube past the narrow window such that successive small sections along the length of the fuel pin are exposed to the neutron flux which passes through the narrow window. (Official Gazette)

Reactor Control Systems

Refer also to abstract 30507.

31929 DRIVING DEVICE FOR REGULATOR RODS OF NUCLEAR REACTORS. Rottger, H.; Schabert, H. P. (to Siemens Aktiengesellschaft). US Patent 3,746,615. 17 Jul 1973. Priority date 11 Oct 1969, F. R. Germany. 6p.

A device for driving the control rods of fluid-cooled nuclear reactors comprises a tubular drive rod from which a regulator rod is suspended. The drive rod is operatively linked with a motion control mechanism, such as a magnetic jack. The tubular wall of the drive rod has openings axially spaced from each other to jointly define a coolant flow path lengthwise through the tubular drive rod. A displaceable shut-off member, preferably a tubular slider, normally closes the flow path inside the tubular drive rod and temporarily opens the path in response to forces exerted by the coolant when the tubular drive rod rapidly travels downward. (Official Gazette)

31930 CONTROL DRIVE FOR A CONTROL ROD FOR NUCLEAR EMERGENCY SHUT DOWN. Acher, H. (to Licentia Patent Verwaltung GmbH). German Patent 1,614,076. 4 Jun 1970. Filed date 2 Aug 1967. (In German).

A control drive for a control rod for nuclear emergency shutdown, which has an energy accumulation chamber for stopping energy outside the reactor pressure vessel is characterized by the fact that the energy accumulation chamber acts directly on the extremity of the control rod, a counter pressure chamber acts in the opposite direction to the control rod, and the energy accumulation chamber and the counter pressure chamber are supplied by a source of pressure agents outside the pressure vessel of the reactor. (TSS)

31931 SCRAM SYSTEM FOR A GAS- OR LIQUID COOLED NUCLEAR REACTOR. Mundt, D. (to Interatom Internationale Atomreaktorbau). German Patent 1,812,086. 11 Jun 1970. Filed date 2 Dec 1968. (In German).

A scram system for stopping and controlling control rods in a nuclear reactor cooled by gas or liquid with a control outside the reactor pressure vessel is described. The system is characterized by a commutation bar with oblique mechanical guides that, at their lower extremity, have a gear rack and a pinion which is connected by a mechanical guide with a control rod that is connected with a coupling circle. (TSS)

31932 CONTROL ROD MECHANISMS FOR FAST REACTORS. Delemontey, P. (Groupement Atomique Alsacienne Atlantique, Le Plessis-Robinson, France); Jacomy, S.; Maulard, M. pp 350-357 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). (In French).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Ger. (9 Oct 1972).

The development and performance of control rod mechanisms for the reactors Phenix and Rapsodie are briefly described. (INIS)

31933 BACKUP CONTROL DRIVE SYSTEM. McKeehan, E. R.; Hikido, K. (General Electric Co., Sunnyvale, CA). pp 358-380 of Engineering of Fast Reactors for Safe and Reliable Operation. Vol. 1. Faude, D. (ed.). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973).

From conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Germany (9 Oct 1972).

The U. S. AEC is presently supporting an LMFBR base program to develop a backup control system. The present effort is focused on criteria and concept evaluation that will lead to the selection of a concept to be pursued through design and testing. In evaluating various systems to meet the LMFBR requirements, a basic consideration is whether the backup shutdown system should, through its own function, protect the reactor system against all accidents to the same degree that the primary system is required to, or only protect against high probability accidents causing gross damage and occurring in conjunction with the low probability that the primary shutdown system does not function. The criteria for GE's system and their rationale are discussed. (INIS)

Nuclear Power Plant Economics

Refer also to abstract 32105.

31934 (ORNL-tr-2676) INTEGRATED NUCLEAR POWER PLANT AND ITS SIGNIFICANCE FOR THE FERROUS METALLURGY INDUSTRY. Wenzel, W.; Wingen, E.; Franke, F. H. Translated by R. G. Mansfield from VDI (Ver. Deut. Ing.) Z.; 111: 1473-1478(1969). 9p. Dep. NTIS $3.00.

A single conventional steel mill cannot consume the energy of a nuclear power plant of industrial size with which it is integrated. Several interconnected mills located in the immediate neighborhood are capable, of course, of doing so, but such a complex would be difficult to establish, for example, in the Ruhr region because of the existing legal conditions (road laws, electrical power supply contracts). The integrated nuclear power plant is eminently suited, however, for supplying cheap power to new industrial complexes soon to be built, consisting of metallurgical plants, chemical plants, and other production plants which use a large amount of energy. (auth)

31935 GOOD TIMES JUST AROUND THE CORNER FOR NUCLEAR POWER. Nature (London); 244: No. 5416, 392-395 (17 Aug 1973).

British nuclear power may finally be about to come into its own. The past and the future of the industry and the United Kingdom Atomic Energy Authority are examined. (auth)

31936 WORLD MARKET FOR COMMERCIAL NUCLEAR POWER PLANT. Nucl. Eng. Int.; 18: No. 208, 697-704(Sep 1973).

With worldwide concern about the energy situation, nuclear power plant forecasts are being considered in a more purposeful

manner than before. To assess what the industry is expected to achieve, an attempt has been made to gather together the most up-to-date projections of installed nuclear generating capacity in various parts of the world and to present in broad terms the implications of the very high growth rate on the various sectors of the nuclear industry. A pull-out chart is included which offers a simple guide to the various reactor systems developed or under development for production of electricity. (UK)

31937 HARD TIMES FOR INDIA'S NUCLEAR PROGRAMME. Gosling, D. (Univ. of Lancaster, Eng.). New Sci.; 59: No. 862, 564-565(6 Sep 1973).

A review of India's atomic power stations in service and under construction, together with their anticipated power performances, is given. It is said that the government now appears to be shifting the emphasis of the power programme away from fast reactors to older, more conventional types, and at the same time trying to indigenise too quickly and in a manner that was never anticipated by the early nuclear planners. Two factors are hampering India's nuclear programme, bureaucracy and obsessive indigenisation. It is concluded that India's political and technological problems are frustrating efforts to establish an indigenous nuclear capability than can make the best use of national fuel deposits. (UK)

Reactor Fuel Cycle Economics

Refer also to abstract 31809.

31938 PROBLEMS OF THE FUEL CYCLE OF FAST BREEDER REACTORS. Schmale, H. (Schnell-Brueter Kernkraftwerksgesellschaft mbH, Essen). Atomwirt., Atomtech.; 18: No. 8-9, 415-418(1973). (In German).

The main problems are the timing and scope of the exercise of options on the waste uranium from enrichment; the decision on the exclusive reservation for breeders of Pu from thermal reactors; the establishment of a technologically and economically efficient fuel element manufacturing industry; the question how, when and where reprocessing should take place; the adaptation of core design and fuel element insertion planning to the boundary conditions of the fuel market. (GE)

Reactor Licensing and Regulation

31939 (DOCKET-50010-188) DRESDEN NUCLEAR POWER STATION, UNIT 1. Scram Setpoint Drift on Channel 5. (Commonwealth Edison Co., Chicago, Ill. (USA)). 29 Jun 1973. 2p. Dep. NTIS $3.00.

31940 (DOCKET-50010-190) DRESDEN NUCLEAR POWER PLANT, UNITS 1, 2, AND 3. Temporary Protection Against Flooding of Critical Equipment. (Commonwealth Edison Co., Chicago, Ill. (USA)). 12 Jul 1973. 6p. (DOCKET-50237-377; DOCKET-50249-277). Dep. NTIS $3.00.

31941 (DOCKET-50010-193) DRESDEN NUCLEAR POWER STATION, UNIT 1. Special Report No. 12: Reactivity Worth of Control Rods. (Commonwealth Edison Co., Chicago, Ill. (USA)). 3 Aug 1973. 25p. Dep. NTIS $3.25.

31942 (DOCKET-50016-206) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Quarterly Operating Report, April-June 1973. (Power Reactor Development Co., Detroit, Mich.). 1973. 17p. Dep. NTIS $3.00.

Sodium unloading; fuel handling and shipping; health physics including waste discharges, personnel exposures, gaseous and liquid samples, sodium activity, environmental surveys, and nuclear material shipments; instrumentation; testing programs; and personnel changes are presented. (FS)

31943 (DOCKET-50016-208) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Retirement Program. (Power Reactor Development Co., Detroit, Mich.). 24 Sep 1973. 18p. Dep. NTIS $3.00.

31944 (DOCKET-50029-265) YANKEE NUCLEAR POWER STATION ABNORMAL OCCURRENCE NO. 73-6: VARIANCE IN THE MAIN COOLANT CHLORIDE CONCENTRATION. (Yankee Atomic Electric Co., Rowe, Mass.). 25 Jul 1973. 1p. Dep. NTIS $3.00.

31945 (DOCKET-50133-130) HUMBOLDT BAY POWER PLANT, UNIT 3. Incidents of Malfunction of a Propane Engine Driven Generator. (Pacific Gas and Electric Co., San Francisco, Calif.). 27 Jul 1973. 2p. Dep. NTIS $3.00.

31946 (DOCKET-50133-136) HUMBOLDT BAY POWER PLANT, UNIT 3. Abnormal Occurrence: Malfunction of One of the Four Reactor High Pressure Trip Sensors. (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 19 Sep 1973. 2p. Dep. NTIS $3.00.

31947 (DOCKET-50206-212) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Report on Loss of Off-Site Power and Subsequent Failure of No. 1 Diesel Generator. (Southern California Edison Co., Rosemead, Calif.). Jul 1973. 4p. Dep. NTIS $3.00.

31948 (DOCKET-50206-223) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Draft Environmental Statement, Response to Federal, State, and Local Agency Comments and Additional Information. (Southern California Edison Co., Rosemead, Calif.). 10 Sep 1973. 107p. Dep. NTIS $7.50.

31949 (DOCKET-50206-230) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Semiannual Operating Report No. 12, January 1-June 30, 1973. (Southern California Edison Co., Rosemead, Calif.). 28 Aug 1973. 28p. Dep. NTIS $3.50.

31950 (DOCKET-50213-220) HADDAM NECK PLANT, UNIT 1. Abnormal Occurrence No. 73-5, Malfunction of a Reactor Containment Isolation Valve. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 22 Jun 1973. 3p. Dep. NTIS $3.00.

A valve failure in the pressurizer liquid phase sample line is described. The valve is isolated by manually operated valves on either side and therefore the malfunction did not represent a safety hazard. (JWR)

31951 (DOCKET-50213-231) HADDAM NECK PLANT, UNIT 1. Abnormal Occurrence: Unplanned Release of Radioactive Material Due to Faulty Valve. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 22 Jun 1973. 1p. Dep. NTIS $3.00.

31952 (DOCKET-50219-290) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report 73-13, Failure of Diesel Generator No. 2 to be Fully Operable During Power Operation Due to Blown Power Transformer Fuses. (Jersey Central Power and Light Co., Morristown, N. J.). 21 Jun 1973. 3p. Dep. NTIS $3.00.

Information on the temporary inoperability of the No. 2 diesel generator due to power transformer fuses being blown during a lightning storm is presented. (JWR)

31953 (DOCKET-50219-291) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence, Failure of a Diesel Generator No. 2 to Be Fully Operable During Power Operation Due to Blowing of Power Transformer Fuses. (Jersey Central Power and Light Co., Morristown, N. J.). 5 Jul 1973. 2p. Dep. NTIS $3.00.

A lightning storm blew three power transformer fuses for the No. 2 diesel generator. This resulted in the inoperability of the fuel oil transfer pumps for the generator since they are among the auxiliaries supplied by the transformer. Although the No. 2 generator would have started and been operable during a loss of off-site power, its fuel supply would have been limited to the quantity in the day tank. (JWR)

31954 (DOCKET-50219-293) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change Request No. 17. The Effect of Passive Central Rods on Heat Transfer During Spray Cooling of BWR Fuel Bundles. (Jersey Central Power and Light Co., Morristown, N. J.). 7 Sep 1973. 42p. Dep. NTIS $4.25.

31955 (DOCKET-50219-305) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Hydraulic Shock and Sway Arrestor Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 6 Aug 1973. 35p. Dep. NTIS $3.75.

31956 (DOCKET-50219-308) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Excessive Activity in the Outside Radwaste Tanks. (Jersey Central Power and Light Co., Morristown, N. J.). 31 Aug 1973. 2p. Dep. NTIS $3.00.

31957 (DOCKET-50219-309) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report 73-14: Increased Rate of Leakage into the Drywell Sump. 24 Jul 1973. 5p. Dep. NTIS $3.00.

31958 (DOCKET-50219-311) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report 73-17: Failure of No. 1 Diesel Generator to Start. (Jersey Central Power

and Light Co., Morristown, N. J.). 8 Aug 1973. 3p. Dep. NTIS $3.00.

31959 (DOCKET-50219-314) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Failure of a Component which Could Have Caused the Failure of No. 1 Diesel Generator to Start. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 17 Aug 1973. 2p. Dep. NTIS $3.00.

31960 (DOCKET-50219-324) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Failure of Transformers Due to Improper Setting of the C Phase Differential Monitoring Relays. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 18 Sep 1973. 5p. Dep. NTIS $3.00.

31961 (DOCKET-50219-325) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Failure of Isolation Condenser NEOIA Condensate Return Valve V-14-34 To Operate During the Last Stages of a Plant Cooldown. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 18 Sep 1973. 2p. Dep. NTIS $3.00.

31962 (DOCKET-50219-326) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Hydraulic Shock and Sway Arrestor Failure. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 21 Sep 1973. 3p. Dep. NTIS $3.00.

31963 (DOCKET-50220-160) NINE MILE POINT NUCLEAR STATION, UNIT 1. Malfunction of 2 Turbine Anticipatory Trip Bypass Switches. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 3 Jul 1973. 2p. Dep. NTIS $3.00.

During routine surveillance testing two out of four turbine anticipatory trip bypass switches were found to exceed the value specified in the instrument surveillance checklist. The switches were recalibrated to place them slightly below the limit. (JWR)

31964 (DOCKET-50220-161) NINE MILE POINT NUCLEAR STATION, UNIT 1. Correspondence Noting that During Routine Surveillance Testing the Core Spray Differential Pressure Instrumentation Was Found to Read Higher Values than Specifications Allow. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 6 Jul 1973. 2p. Dep. NTIS $3.00.

31965 (DOCKET-50220-174) NINE MILE POINT NUCLEAR STATION, UNIT 1. Occurrence of a Reactor Scram During Routine Surveillance Testing of Main Steam Isolation Valves. (Niagara Mohawk Power Corp., Lycoming, N. Y.). 1 Aug 1973. 2p. Dep. NTIS $3.00.

31966 (DOCKET-50237-353) DRESDEN NUCLEAR POWER STATION, UNIT 2. HPCI Motor Operated Valve Failures. (Commonwealth Edison Co., Chicago, Ill. (USA)). 24 Aug 1973. 2p. Dep. NTIS $3.00.

31967 (DOCKET-50237-373) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. High Activity in Above Ground Tank B Floor Drain Sample Tank. (Commonwealth Edison Co., Chicago, Ill. (USA)). 10 Aug 1973. 5p. (50249-273). Dep. NTIS $3.00.

31968 (DOCKET-50237-393) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. High Activity in Above Ground Floor Drain Sample Tank B. (Commonwealth Edison Co., Chicago, Ill. (USA)). 17 Jul 1973. 3p. (DOCKET-50249-289). Dep. NTIS $3.00.

31969 (DOCKET-50244-200) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report: Failure of Safety Injection System Bistable to De-energize on Test. (Rochester Gas and Electric Corp., N. Y.). 27 Jul 1973. 2p. Dep. NTIS $3.00.

31970 (DOCKET-50244-209) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Site Contingency Plans, SC-1 Through SC-5. (Rochester Gas and Electric Corp., N.Y. (USA)). 1 Oct 1973. 84p. Dep. NTIS $6.25.

Procedures to be followed in major radioactivity releases to the atmosphere or lake during adverse weather conditions such as high winds, hurricanes, tornado watches and warnings, fires, flooding of Deer Creek or Lake Ontario, or from large pipe breaks, and for major or minor earthquake tremors are presented. (FS)

31971 (DOCKET-50245-262) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence: Discovery of a Leak in the One-Inch Stainless Steel Containment Penetration Piping. (Millstone Point Co., Hartford, Conn.). 6 Aug 1973. 2p. Dep. NTIS $3.00.

31972 (DOCKET-50245-263) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Unusual Event: Rod 18-35 Went to the Overtravel Position While Being Exercised for a Shutdown Margin Check. (Millstone Point Co., Hartford, Conn.). 8 Aug 1973. 1p. Dep. NTIS $3.00.

31973 (DOCKET-50245-271) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence No. AO-73-9: Discrepancy Between the Two Independent Reactor Level Sensing Devices. (Millstone Point Co., Hartford, Conn. (USA)). 14 Aug 1973. 1p. Dep. NTIS $3.00.

31974 (DOCKET-50245-280) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Information Re Shock Arrestor Failures. (Millstone Point Co., Hartford, Conn. (USA)). 18 Jul 1973. 2p. Dep. NTIS $3.00.

31975 (DOCKET-50245-281) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence AO-73-7: Potential Problem with Reactor Control Blades. (Millstone Point Co., Hartford, Conn. (USA)). 18 Jul 1973. 4p. Dep. NTIS $3.00.

31976 (DOCKET-50245-282) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Evaluation of the Effects of the Control Blade Manufacturing Defect on Reactor Operation. (Millstone Point Co., Hartford, Conn. (USA)). 27 Jul 1973. 6p. Dep. NTIS $3.00.

31977 (DOCKET-50245-283) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Information Re Shock Suppressor Failures. (Millstone Point Co., Hartford, Conn. (USA)). 31 Jul 1973. 2p. Dep. NTIS $3.00.

31978 (DOCKET-50245-293) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Malfunction of Core Spray Pump Suction Valve 1-CS-2A. (Millstone Point Co., Hartford, Conn. (USA)). 30 Aug 1973. 1p. Dep. NTIS $3.00.

31979 (DOCKET-50245-294) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Addendum 2 to Interim Report, Feedwater Sparger Failure Evaluation of Design No. 3; Test Results. (Millstone Point Co., Hartford, Conn. (USA)). 21 Sep 1973. 79p. Dep. NTIS $6.00.

31980 (DOCKET-50245-296) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report AO-73-10: Discrepancy Between the Two Independent Reactor Level Sensing Columns. (Millstone Point Co., Hartford, Conn. (USA)). 1 Oct 1973. 1p. Dep. NTIS $3.00.

31981 (DOCKET-50245-297) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report AO-73-11: While Performing Maintenance in the B Reactor Feed Pump, the A Condensate Booster Pump Outboard Bearing Temperature Began to Trend in an Upward Direction. (Millstone Point Co., Hartford, Conn. (USA)). 1 Oct 1973. 1p. Dep. NTIS $3.00.

31982 (DOCKET-50247-126) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence No. 3-2-11: Failure in the High Steam Flow Safety Circuit. (Consolidated Edison Co. of New York, Inc., New York). 6 Sep 1973. 2p. Dep. NTIS $3.00.

31983 (DOCKET-50247-127) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence No. 3-2-9: First Stage Turbine Pressure Setting in Excess of Limit. (Consolidated Edison Co. of New York, Inc., New York). 12 Jul 1973. 2p. Dep. NTIS $3.00.

During routine testing and calibration activities, it was discovered that the first stage turbine pressure setting was slightly in excess of the limit given in the Technical Specification. This was corrected by resetting the instrument. Also, one of two safety injection steam flow bi-stables in Loop No. 24 was set slightly high. This was corrected by replacing the bi-stable. (JWR)

31984 (DOCKET-50247-129) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence No. 3-2-5: Change of Analysis of Causative Factors Indicating that the Refrigerant Expansion Valve was Improperly Set. (Consolidated Edison Co. of New York Inc., New York). 23 Jul 1973. 2p. Dep. NTIS $3.00.

31985 (DOCKET-50247-136) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. 3-2-10: Malfunction of the Limiting Safety System Setting of Channel III of the Overpower-Overtemperature Delta-T Reactor Trip Circuitry. (Consolidated Edison Co. of New York, Inc., New York (USA)). 16 Aug 1973. 2p. Dep. NTIS $3.00.

31986 (DOCKET-50249-268) DRESDEN NUCLEAR POWER STATION, UNIT 3. Fast Closure of MSIV 3-203-1B. (Commonwealth Edison Co., Chicago, Ill.). 7 Aug 1973. 2p. Dep. NTIS $3.00.

31987 (DOCKET-50249-271) DRESDEN NUCLEAR POWER STATION, UNIT 3. Correspondence Re Fast Closure Time of "1B" MSIV. (Commonwealth Edison Co., Chicago, Ill.). 23 Aug 1973. 1p. Dep. NTIS $3.00.

31988 (DOCKET-50249-284) DRESDEN NUCLEAR POWER STATION, UNIT 3. Transient Analyses for Cycle 2 Using Current Methods. (Commonwealth Edison Co., Chicago, Ill. (USA)). 2 Jul 1973. 31p. Dep. NTIS $3.75.

31989 (DOCKET-50250-142) TURKEY POINT PLANT, UNIT 3. Abnormal Occurrence No. 3-73-6, Accumulator Level Limiting Conditions for Operation Exceeded. (Florida Power and Light Co.). 20 Jul 1973. 4p. Dep. NTIS $3.00.

An occurence in which the safety injection accumulator level exceeded the Technical Specification limit is described. This event did not adversely affect the safe operation of the plant. (JWR)

31990 (DOCKET-50250-143) TURKEY POINT PLANT, UNIT 3. Abnormal Occurrence No. 3-73-7, Fuel Cladding Defects. (Florida Power and Light Co.). 20 Jul 1973. 4p. Dep. NTIS $3.00.

Routine reactor coolant sample analysis on July 11, 1973 indicated an increase in gross radioactivity. Further analysis revealed that the increased radioactivity was due to fuel cladding defects. A complete evaluation showed the relatively small quantities of radioactivity in the coolant represent a small fraction of the 1% fuel defects with which the reactor can operate safely. (JWR)

31991 (DOCKET-50250-144) TURKEY POINT PLANT; UNIT 3. Abnormal Occurrence No. 3-73-5: Failure to Auto Transfer Auxiliary Power to Startup Transformer. (Florida Power and Light Co.). 13 Jul 1973. 4p. Dep. NTIS $3.00.

Following a reactor and turbine-generator trip caused by spurious Safety Injection System actuation, automatic transfer to auxiliary power supply from the auxiliary transformer to the startup transformer did not occur. The problem was traced to an uninstalled connecting wire in the automatic circuitry between the Safety Injection actuation relay and the relay that closes the startup transformer breakers. (JWR)

31992 (DOCKET-50251-132) TURKEY POINT PLANT, UNIT 4. Abnormal Occurrence No. 4-73-8, Inoperable Intake Cooling Water Pumps. (Florida Power and Light Co.). 20 Jul 1973. 4p. Dep. NTIS $3.00.

A condition in which two of three intake cooling water pumps were inoperable in violation of limiting conditions for plant operation is described. (JWR)

31993 (DOCKET-50251-136) TURKEY POINT PLANT, UNIT 4. Abnormal Occurrence Report 4-73-7: Failure of Auxiliary Feedwater Pumps to Auto Start. (Florida Power and Light Co.). 28 Jun 1973. 4p. Dep. NTIS $3.00.

31994 (DOCKET-50254-237) QUAD-CITIES STATION, UNITS 1 AND 2. Abnormal Occurrence: Primary Containment Was Not Inerted to Less Than 5% Oxygen Content Within 24 Hours of Placing the Mode Switch into RUN. (Commonwealth Edison Co., Cordova, Ill.). 17 Aug 1973. 2p. (DOCKET-50265-230). Dep. NTIS $3.00.

31995 (DOCKET-50254-239) QUAD-CITIES STATION, UNITS 1 AND 2. Shutdown Margin Testing and Investigation of Reactivity Differences Between Symmetric Core Locations. (Commonwealth Edison Co., Chicago, Ill). 3 Aug 1973. 10p. (DOCKET-50265-233). Dep. NTIS $3.00.

31996 (DOCKET-50254-245) QUAD-CITIES STATION, UNITS 1 AND 2. Abnormal Occurrence: Reactor Building Ventilation Stack Sample Cartridges Indicated Excess of ^{131}I and Particulates with Half-Lives >8 Days. (Commonwealth Edison Co., Cordova, Ill. (USA)). 11 Aug 1973. 4p. (DOCKET-50265-238). Dep. NTIS $3.00.

31997 (DOCKET-50254-256) QUAD-CITIES STATION, UNITS 1 AND 2. Abnormal Occurrence: Reactor Building Ventilation Stack Sample Cartridges Indicated an Excessive Release of ^{131}I and Particulates with Half Lives >8 Days. (Commonwealth Edison Co., Cordova, Ill. (USA)). 16 Aug 1973. 3p. (DOCKET-5C265-248). Dep. NTIS $3.00.

31998 (DOCKET-50254-257) QUAD-CITIES STATION, UNIT 1. Abnormal Occurrence: the Setpoint of a Pressure Switch in the Reactor Protection System Was Found to Exceed the Limiting Condition for Operation. (Commonwealth Edison Co., Cordova, Ill. (USA)). 12 Sep 1973. 2p. Dep. NTIS $3.00.

31999 (DOCKET-50255-186) PALISADES NUCLEAR PLANT. Abnormal Occurrence: Excessive Release of Radioiodine Via the Plant Stack During a Purge. (Consumers Power Co., Jackson, Mich.). 24 Aug 1973. 3p. Dep. NTIS $3.00.

32000 (DOCKET-50255-188) PALISADES NUCLEAR PLANT. Increase in the Primary to Secondary Leakage in the B Steam Generator. (Consumers Power Co., Jackson, Mich.). 8 Aug 1973. 2p. Dep. NTIS $3.00.

32001 (DOCKET-50255-190) PALISADES NUCLEAR PLANT. Abnormal Occurrence Report No. AO-08-73: Failure of the In-Core Scan. (Consumers Power Co., Jackson, Mich. (USA)). 16 Aug 1973. 2p. Dep. NTIS $3.00.

32002 (DOCKET-50255-199) PALISADES NUCLEAR PLANT. License DPR-20, Technical Specifications, Proposed Change to Incorporate a New Environmental Monitoring Program. First Annual Progress Report on an Investigation of the Meteorological Impact of Mechanical-Draft Cooling Towers. Plan to Study the Effects of Cooling Tower Drift on Terrestrial Vegetation. (Consumers Power Co., Jackson, Mich. (USA)). 28 Sep 1973. 62p. Dep. NTIS $5.25.

32003 (DOCKET-50259-122) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Final Report on Failures of EGB Governor on Emergency Diesel-Generator B, Model 999-20-645E4. (Tennessee Valley Authority, Chattanooga). 30 Jul 1973. 4p. Dep. NTIS $3.00.

32004 (DOCKET-50259-125) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Failure of Electrical Penetration EF, Connector 9E. (Tennessee Valley Authority, Chattanooga). 30 Jul 1973. 7p. Dep. NTIS $3.00.

32005 (DOCKET-50259-127) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Failure of EGM Speed Control and Governor for the RCIC Turbine. (Tennessee Valley Authority, Chattanooga). 30 Jul 1973. 5p. Dep. NTIS $3.00.

32006 (DOCKET-50259-128) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BFEAO-731W: Details of Three Incidents When a Number of Gizzard Shad Minnows Were Impinged on Intake Screens. (Tennessee Valley Authority, Chattanooga). 3 Aug 1973. 2p. Dep. NTIS $3.00.

32007 (DOCKET-50259-183) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO 7317W: Reversed Instrument Sensing Lines on RCIC Turbine Steamline High Flow Differential Pressure Switch PdIS-71-1A. (Tennessee Valley Authority, Chattanooga (USA)). 5 Oct 1973. 2p. Dep. NTIS $3.00.

32008 (DOCKET-50261-229) H. B. ROBINSON, UNIT 2. Correspondence on Violation of High Steam Line Flow Setpoint. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 31 Aug 1973. 2p. Dep. NTIS $3.00.

32009 (DOCKET-50261-239) H. B. ROBINSON, UNIT 2. Safety Injection Accumulator Volumes Below Technical Specification Requirements. (Carolina Power and Light Co., Raleigh, N. C.). 9 Aug 1973. 2p. Dep. NTIS $3.00.

32010 (DOCKET-50261-244) H. B. ROBINSON, UNIT 2. Safety Injection System Status. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 7 Sep 1973. 33p. Dep. NTIS $3.75.

A report of the safety injection system status, a history of developments involving the system, and a summary of the system tests are presented. (JWR)

32011 (DOCKET-50261-253) H. B. ROBINSON PLANT, UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels, August 1973. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 20 Sep 1973. 2p. Dep. NTIS $3.00.

32012 (DOCKET-50261-256) H. B. ROBINSON PLANT, UNIT 2. Additional Information Concerning Loss-of-Coolant Analysis. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 1 Oct 1973. 6p. Dep. NTIS $3.00.

32013 (DOCKET-50263-243) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Cycle 2 Startup Report. (Northern States Power Co., Minneapolis, Minn.). Jul 1973. 10p. Dep. NTIS $3.00.

32014 (DOCKET-50263-245) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. License DPR-22 Abnormal Occurrence: Depressurizing of the T-ring Seal on the Air Operated Primary Containment Outboard Purge/Vent Valve AO-2387. (Northern States Power Co., Minneapolis, Minn.). 26 Jul 1973. 2p. Dep. NTIS $3.00.

32015 (DOCKET-50263-246) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Procedure for the Periodic Testing of the Primary Containment Instrument Line Excess Flow Check Valves. (Northern States Power Co., Minneapolis, Minn.). 27 Jul 1973. 2p. Dep. NTIS $3.00.

32016 (DOCKET-50263-248) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Cycle 2 Startup Report, Supplemental Information. (Northern States Power Co., Minneapolis, Minn.). 9 Aug 1973. 5p. Dep. NTIS $3.00.

32017 (DOCKET-50267-72) FORT ST. VRAIN NUCLEAR GENERATING STATION. Deficiency Report on the Helium Circulators. (Public Service Co. of Colorado, Denver (USA)). 1972. 9p. Dep. NTIS $3.00.

32018 (DOCKET-50269-127) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-2, Incore Instrument Tube Leak. (Duke Power Co., Charlotte, N. C.). 17 Jul 1973. 3p. Dep. NTIS $3.00.

Information concerning an incore instrument tube leak into the incore instrument handling tank is presented. The corrective measures taken are described. (JWR)

32019 (DOCKET-50269-128) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence No. AO-269/73-4: Reactor Coolant System Instrumentation Tubing Leak. (Duke Power Co., Charlotte, N. C. (USA)). 27 Jul 1973. 4p. Dep. NTIS $3.00.

32020 (DOCKET-50269-129) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Thrust Movement Monitoring Program for Main Steam Bypass to Condenser and Mechanical Power Piping Support System Quality Assurance Monitoring Program for LP Injection System No. 53. (Duke Power Co., Charlotte, N. C.). 1 Aug 1973. 139p. (DOCKET-50270-98; DOCKET-50287-89). Dep. NTIS $9.00.

32021 (DOCKET-50269-136) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence No. AO-73-3: Failure to Maintain Containment Integrity. (Duke Power Co., Charlotte, N. C.). 10 Jul 1973. 6p. Dep. NTIS $3.00.

32022 (DOCKET-50269-138) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report No. UE-269/73-7: Failure of an Engineered Safeguards Valve to Close on Signal. (Duke Power Co., Charlotte, N.C.). 31 Jul 1973. 3p. Dep. NTIS $3.00.

32023 (DOCKET-50269-139) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report UE-269/73-5: Failure of On Site Power Source to Start on Signal. (Duke Power Co., Charlotte, N.C.). 6 Aug 1973. 2p. Dep. NTIS $3.00.

32024 (DOCKET-50270-111) OCONEE NUCLEAR STATION, UNIT 2. Integrated Leak Rate Test of the Reactor Containment Building. (Duke Power Co., Charlotte, N.C. (USA)). 3 Oct 1973. 425p. Dep. NTIS $23.25.

32025 (DOCKET-50271-199) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. AO-73-18, Barton Differential Pressure Switch Sensing RCIC Steam Line High Differential Pressure Actuated. (Vermont Yankee Nuclear Power Corp., Rutland). 3 Jul 1973. 1p. Dep. NTIS $3.00.

32026 (DOCKET-50271-210) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. AO-73-24: Inoperability of the Pressure Suppression Chamber Reactor Building Vacuum Breaker System. (Vermont Yankee Nuclear Power Corp., Rutland). 22 Aug 1973. 2p. Dep. NTIS $3.00.

32027 (DOCKET-50271-211) VERMONT YANKEE NUCLEAR POWER STATION. Device to Prevent the Dropping of a Fuel Cask Should a Failure of a Reactor Building Crane Component Occur. (Vermont Yankee Nuclear Power Corp., Rutland). 23 Jul 1973. 6p. Dep. NTIS $3.00.

32028 (DOCKET-50271-213) VERMONT YANKEE NUCLEAR POWER STATION. Report on Failures of Main Steam Isolation Valves and Corrective Actions to Assure Operability. (Vermont Yankee Nuclear Power Corp., Rutland). 3 Aug 1973. 10p. Dep. NTIS $3.00.

32029 (DOCKET-50271-218) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. AO-73-26: An Apparent Detonation in the Off-Gas System Caused Sufficient Back Pressure to Fracture the Air Ejector Rupture Disc. (Vermont Yankee Nuclear Power Corp., Rutland). 11 Sep 1973. 3p. Dep. NTIS $3.00.

32030 (DOCKET-50271-222) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. AO-73-28: Malfunction of a Microswitch Installed in DPIS 2-129B. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 11 Sep 1973. 1p. Dep. NTIS $3.00.

32031 (DOCKET-50272-76) SALEM NUCLEAR GENERATING STATION, UNIT 1. Dye Penetrant Indications Observed on the Surface of the 67° Reactor Coolant Nozzle Safe End. (Public Service Electric and Gas Co., Newark, N. J.). 24 Jul 1973. 3p. Dep. NTIS $3.00.

Dye penetrant indications were observed on the surface of the 67° reactor coolant nozzle safe end during inspection of the adjacent field weld. Exploratory grinding and an in-place metallographic examination indicated that no repair was necessary. (JWR)

32032 (DOCKET-50275-49) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 1. Incident Report: Cracking of Thermoplastic Insulation and Corrective Action Taken. (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 31 May 1973. 2p. Dep. NTIS $3.00.

32033 (DOCKET-50275-51) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Operating License Application. (Pacific Gas and Electric Co., San Francisco, Calif.). 28 Sep 1973. 41p. (Docket-50323-48). Dep. NTIS $4.25.

32034 (DOCKET-50277-121) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Significant Deficiency Report SDR No. 6: Torus Coating Failure. (Philadelphia Electric Co., PA). 19 Jul 1973. 6p. Dep. NTIS $3.00.

32035 (DOCKET-50277-123) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: Malfunction of Reactor Level Indicating Switch LIS-2-2-3-101B. (Philadelphia Electric Co., PA). 31 Aug 1973. 2p. Dep. NTIS $3.00.

32036 (DOCKET-50280-161) SURRY POWER STATION, UNIT 1. RO Inquiry Report No. 73-2Q, Violation of Upper Pressurization Limit, January 27, 1973. (Virginia Electric and Power Co., Richmond). 28 Jun 1973. 5p. Dep. NTIS $3.00.

Information on a pressure peak in the primary system which exceeded the limiting condition for operation in Technical Specification 3.1 B1 is presented. (JWR)

32037 (DOCKET-50280-162) SURRY POWER STATION, UNIT 1. RO Inquiry Report No. 73-3Q, Containment Spray Pump Failure. (Virginia Electric and Power Co., Richmond). 28 Jun 1973. 5p. Dep. NTIS $3.00.

Information on the failure of the 1B containment spray pump to start during routine monthly testing is presented. (JWR)

32038 (DOCKET-50280-163) SURRY POWER STATION, UNIT 1. RO Inquiry Report No. 73-4Q, Safety Injection and Main Steam Isolation Valve Failure. (Virginia Electric and Power Co., Richmond). 28 Jun 1973. 4p. Dep. NTIS $3.00.

32039 (DOCKET-50280-173) SURRY POWER STATION, UNITS 1 AND 2. Unusual Safety Related Event Report No. USRE-S1-73-03: Malfunction of Three Portions of the Process Monitoring Subsystem of the Radiation Monitoring System. (Virginia Electric and Power Co., Richmond). 1 Aug 1973. 5p. (DOCKET-50281-142). Dep. NTIS $3.00.

32040 (DOCKET-50280-177) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-73-09: Failure of Turbine Driven Auxiliary Feedwater Pump Steam Supply Valve MOV-MS-102. (Virginia Electric and Power Co., Richmond). 12 Sep 1973. 8p. Dep. NTIS $3.00.

32041 (DOCKET-50281-125) SURRY POWER STATION, UNIT 2. Abnormal Occurrence Report AO-S2-73-04: Leak in Feedwater Check Valve. (Virginia Electric and Power Co., Richmond). 29 Jun 1973. 7p. Dep. NTIS $3.00.

32042 (DOCKET-50281-137) SURRY POWER STATION, UNIT 2. Abnormal Occurrence No. AO-S2-73-05: Failure of Pressure Control Valve PCV-GW-107. (Virginia Electric and Power Co., Richmond). 3 Jul 1973. 9p. Dep. NTIS $3.00.

32043 (DOCKET-50282-150) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Interim Report on Valve

Operators with Unsatisfactory Insulation and Seals Within Containment. (Northern States Power Co., Minneapolis, Minn.). 13 Jul 1973. 2p. (DOCKET-50306-128). Dep. NTIS $3.00.

32044 (DOCKET-50293-155) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence No. AO-73-27: Incorrect Calibration of IRM Channels. (Boston Edison Co., Mass.). 6 Sep 1973. 2p. Dep. NTIS $3.00.

32045 (DOCKET-50293-158) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence No. AO-73-22, Failure of Barksdale Model Pressure Switches. (Boston Edison Co., Mass. (USA)). 16 Jul 1973. 1p. Dep. NTIS $3.00.

32046 (DOCKET-50293-166) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence No. UO-73-8: Inoperability of Reactor Building to Suppression Chamber Vacuum Breaker Valve AO-5040A. (Boston Edison Co., Mass.). 5 Jul 1973. 2p. Dep. NTIS $3.00.

32047 (DOCKET-50293-171) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence UO-73-9: Inoperability of RHR Inboard Injection Valve MO-1001-29A. (Boston Edison Co., Mass. (USA)). 2 Aug 1973. 1p. Dep. NTIS $3.00.

32048 (DOCKET-50293-172) PILGRIM NUCLEAR POWER STATION, UNIT 1. License DPR-35. Abnormal Occurrence No. AO-73-29: Pressure Switch, Barksdale Model B2T-M12SS, Actuation Setpoint Anomaly. (Boston Edison Co., Mass. (USA)). 23 Sep 1973. 2p. Dep. NTIS $3.00.

32049 (DOCKET-50293-178) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-28: Malfunction of the "D" Relief/Safety Valve Located on Main Steam Line "B" Inside the Drywell. (Boston Edison Co., Mass.). 8 Sep 1973. 2p. Dep. NTIS $3.00.

32050 (DOCKET-50293-183) PILGRIM NUCLEAR POWER STATION, UNIT 1. Semiannual Report No. 2 on the Environmental Radiation Monitoring Program, January–June 1973. (Boston Edison Co., Mass. (USA)). 29 Aug 1973. 83p. Dep. NTIS $6.25.

The reactor operation averaged 85% of full power. While the integrated radionuclide discharges in the gaseous effluent increased, liquid effluents were maintained at low levels with minimum liquid releases. There were no significant increases in environmental radioactivity levels beyond the station, but onsite levels increased near the turbine building and were attributed to the N-16 present in the turbine steam. Cs-137 concentration in the seawater in the discharge canal was slightly higher than at the intake canal. No detectable Mn-54, Co-58, Co-60, or Zn-65 was found and no significant radioactivity was detected in the bottom sediment of the discharge canal. (FS)

32051 (DOCKET-50293-184) PILGRIM NUCLEAR POWER STATION, UNIT 1. Semiannual Report No. 2 on Marine Ecology Studies, January–June 1973. (Boston Edison Co., Mass. (USA)). 28 Sep 1973. 260p. Dep. NTIS $15.00.

The status and results of surveillance of marine ecology, benthic and thermal plume studies, dissolved oxygen analysis and menhaden mortalities caused by gas bubble disease, and the effects of cooling water entrainment on phytoplankton, zooplankton, fish eggs, fish larvae, and lobster larva are presented. (FS)

32052 (DOCKET-50295-161) ZION NUCLEAR PLANT, UNIT 1. License DPR-39, Abnormal Occurrence No. 0407: Reactor Trip Caused by Low Level in Conjunction with a Steam Flow-Feed Flow Mismatch in Steam Generator B. (Commonwealth Edison Co., Chicago, Ill.). 23 Aug 1973. 3p. Dep. NTIS $3.00.

32053 (DOCKET-50295-163) ZION NUCLEAR PLANT, UNIT 1. Positive Displacement Charging Pump Relief Line Weld Separation. (Commonwealth Edison Co., Zion, Ill. (USA)). 1 Aug 1973. 2p. Dep. NTIS $3.00.

32054 (DOCKET-50295-175) ZION NUCLEAR PLANT, UNIT 1. Abnormal Occurrence: Improper Calibration of Steam Flow Transmitters. (Commonwealth Edison Co., Zion, Ill. (USA)). 30 Jul 1973. 2p. Dep. NTIS $3.00.

32055 (DOCKET-50295-176) ZION NUCLEAR PLANT, UNIT 1. Semiannual Operating Report, June 19–June 30, 1973. (Commonwealth Edison Co., Chicago, Ill. (USA)). 26 Sep 1973. 28p. Dep. NTIS $3.50.

32056 (DOCKET-50305-90) KEWAUNEE NUCLEAR POWER PLANT, UNIT 1. Pipe Rupture Analyses of Feedwater Piping Outside Containment. (Wisconsin Public Service Corp., Green Bay). 28 Aug 1973. 142p. Dep. NTIS $9.25.

32057 (DOCKET-50305-105) KEWAUNEE NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Holdup Tank 1C Collapse. (Wisconsin Public Service Corp., Green Bay). 12 Jul 1973. 3p. Dep. NTIS $3.00.

32058 (DOCKET-50305-112) KEWAUNEE NUCLEAR POWER PLANT. Safety Injection Pump Motor Replacement. (Wisconsin Public Service Corp., Green Bay (USA)). 22 Aug 1973. 3p. Dep. NTIS $3.00.

32059 (DOCKET-50309-131) MAINE YANKEE ATOMIC POWER PLANT. Reports on Operational Difficulties with CEA No. 42 and 43. (Maine Yankee Atomic Power Co., Westboro, Mass.). 11 Jul 1973. 5p. Dep. NTIS $3.00.

32060 (DOCKET-50309-137) MAINE YANKEE ATOMIC POWER PLANT. Semiannual Environmental Surveillance Report II, January 1–June 30, 1973. (Maine Yankee Atomic Power Co., Westboro, Mass. (USA)). 28 Sep 1973. 312p. Dep. NTIS $17.75.

During this period, the reactor power level was limited to a maximum of 75% of full power. Surveillance is reported for the thermal limits of the plant cooling water system, control of Montsweag Bay, water temperature in the vicinity of Long Ledge, chemical discharge limits, fish entrapment limits, effects of the condenser cooling water on plankton and larval organisms, and estuary water temperature. (FS)

32061 (DOCKET-50309-140) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence No. 73-4: Discrepancy in the Application of Flux Peaking Augmentation Factors. (Maine Yankee Atomic Power Co., Wiscasset (USA)). 2 Oct 1973. 1p. Dep. NTIS $3.00.

32062 (DOCKET-50317-115) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Significant Deficiency Holes Drilled into South Face of Dividing Wall Pierced Wall of Cooling Water Return Line. (Baltimore Gas and Electric Co., MD). 30 Jul 1973. 2p. Dep. NTIS $3.00.

32063 (DOCKET-50327-46) SEQUOYAH NUCLEAR PLANT, UNIT 1. Failure of Jacket Water Temperature Regulating Valves on Emergency Diesel Generator. (Tennessee Valley Authority, Chattanooga). 30 Jul 1973. 4p. Dep. NTIS $3.00.

32064 (DOCKET-50329-43) MIDLAND PLANT, UNITS 1 AND 2. Environmental Aspects of Bullock Creek Rerouting. (Consumers Power Co., Jackson, Mich.). 10 Aug 1973. 32p. (Docket-50330-42). Dep. NTIS $3.75.

32065 (DOCKET-50331-113) DUANE ARNOLD ENERGY CENTER. Additional Information re Unauthorized Heating and Bending of Pipe. (Iowa Electric Light and Power Co., Cedar Rapids (USA)). 8 Aug 1973. 3p. Dep. NTIS $3.00.

32066 (DOCKET-50331-114) DUANE ARNOLD ENERGY CENTER. Environmental Monitoring Program, Quarterly Report Covering January 1–March 31, 1973 and Annual Summary. (Iowa Electric Light and Power Co., Cedar Rapids). 30 Jul 1973. 68p. Dep. NTIS $5.50.

Existing radioactivity in airborne particulates, ambient radiation levels at 64 locations at the site, Cedar River water samples, river bottom sediments, soils, vegetation, livestock, poultry, milk, fish, aquatic biota, and wildlife are documented. The adequacy of the monitoring methods and the suitability of the sampling program and equipment are discussed. (FS)

32067 (DOCKET-50341-67) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Recirculation Pump/Motor Overspeed. (Detroit Edison Co., Mich.). 2 Aug 1973. 28p. Dep. NTIS $3.50.

32068 (DOCKET-50344-75) TROJAN NUCLEAR PLANT. Preoperational Radiation Survey. (Portland General Electric Co., Oreg.). 7 Aug 1973. 43p. (PGE-1005). Dep. NTIS $4.25.

32069 (DOCKET-50344-77) TROJAN NUCLEAR PLANT. License Application, FSAR, Amendment 4. (Portland General Electric Co., Oreg. (USA)). 28 Sep 1973. 529p.

32070 (DOCKET-50397-46) HANFORD NO. 2 NUCLEAR POWER PLANT. Information Regarding Cadweld Splice Sleeves in Reactor Building Mat. (Washington Public Power Supply System, Richland (USA)). 15 Aug 1973. 3p. Dep. NTIS $3.00.

32071 (DOCKET-50460-1) WPPSS NUCLEAR PROJECT NO. 1. License Application and Information Requested by the Attorney General for Antitrust Review. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 322p. Dep. NTIS $18.25.

The license application and information concerning the antitrust review and participants and contracts are presented. (FS)

32072 (DOCKET-50460-2) WPPSS NUCLEAR PROJECT NO. 1. License Application, PSAR, Volume 1. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 541p. Dep. NTIS $29.25.

The WNP-1 Reactor will replace the N-Reactor with a two-loop PWR similar to those at Bellefonte and Greenwood and will be housed in a reinforced concrete containment. A topping turbine will be added to the existing low pressure turbines. The plant will operate at core power levels up to 3600 MW(t) corresponding to a nuclear supply system thermal output of 3619 MW(t) and an electrical power output of 1206 MW(e). The site is adjacent to the N Reactor on the Hanford Reservation on the Columbia River 30 miles NW of Richland. The general description and site characteristics including the geography, demography, meteorology, hydrology and seismology are presented. (FS)

32073 (DOCKET-50460-3) WPPSS NUCLEAR PROJECT NO. 1. License Application, PSAR, Volume 2. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 488p. Dep. NTIS $26.50.

Appendices to the site characteristics including geologic regional and site investigations; geologic mapping of Gable Butte and mountain; geologic mapping of Saddle Mountains, Hanson Creek Structure, and the Umtanum Ridge; continuity survey of the Upper Ringold formation in the White Bluffs; on-site exploration trenches; exploratory drill hole data; bore hole data; petrographic analysis of basalt from bedrock borings; geochemical correlation of basalt flows; paleomagnetism of basalt flows; final geophysical borehole investigation; in-situ compressional and shear wave velocity measurements; seismic refraction survey, earthquakes affecting area; subsurface investigation and foundation engineering evaluation; and a letter on roads, railroads, power lines and communication lines are presented. (FS)

32074 (DOCKET-50460-4) WPPSS NUCLEAR PROJECT NO. 1. License Application, PSAR, Volume 3. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 618p. Dep. NTIS $33.00.

The mechanical, nuclear, thermal, and hydraulic design bases for the PWR type reactor are described. Design criteria concerning structures, components, equipment, and systems are presented and include conformance with AEC design criteria; classification of structures, systems, and components; wind and tornado loading; water level (flood) design; missile protection; protection against pipe rupture; seismic design; design of Category 1 structures, systems, and components; seismic design of Category 1 instruments and electrical equipment; and environmental design. (FS)

32075 (DOCKET-50460-5) WPPSS NUCLEAR PROJECT NO. 1. License Application, PSAR, Volume 4. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 582p. Dep. NTIS $31.25.

The safety analysis of the reactor cooling system and connected systems, engineered safety features, and instrumentation and controls is presented including the integrity of the reactor coolant pressure boundary, thermal-hydraulic system design, reactor vessel and appurtenances design bases, component and subsystem design, instrumentation requirements, containment systems, ECCS, habitability systems, protection system, engineered safety features actuation systems, systems required for safe shutdown, safety related display systems, other systems required for safety, control systems not required for safety, other instrumentation, auxiliary equipment, and equipment in the computer room. (FS)

32076 (DOCKET-50460-6) WPPSS NUCLEAR PROJECT NO. 1. License Application, PSAR, Volume 5. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 415p. Dep. NTIS $22.75.

Offsite and onsite power systems and auxiliary systems including fuel storage and handling, water systems, process auxiliaries, air conditioning, heating, ventilation, cooling, fire protection, communications, lighting, and systems concerning the diesel generators are presented. An appendix on General Services Building Interactions is included. (FS)

32077 (DOCKET-50460-7) WPPSS NUCLEAR PROJECT NO. 1. License Application, PSAR, Volume 6. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 349p. Dep. NTIS $19.50.

The steam and power conversion system including the turbine generator, main steam supply system, main condenser, turbine gland sealing and bypass systems, circulating water system, condensate cleanup, condensers, and feedwater systems is presented. Liquid, solid, and gaseous wastes management, process and effluent radiological monitoring and the offsite radiological monitoring programs are described. Appendices on Calculational Methods for Radioactive Transport and the Liquid Waste System Recycle Concept are included. The shielding, ventilation and the health physics program are discussed. (FS)

32078 (DOCKET-50460-8) WPPSS NUCLEAR PROJECT NO. 1. License Application, PSAR, Volume 7. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 589p. Dep. NTIS $31.50.

Information concerning the conduct of operations, initial tests and operation, accident analyses, preliminary technical specifications, and quality assurance is described. Appendices on radiation sources and the mathematical model used for determining fission product transport from the core are presented. (FS)

32079 (DOCKET-50460-9) WPPSS NUCLEAR PROJECT NO. 1. Environmental Report, Volume 1. (Washington Public Power Supply System, Richland (USA)). 15 Oct 1973. 842p. Dep. NTIS $44.25.

The environmental effects of construction and operation of the WNP-1 reactor are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

GENERAL

Civilian Defense

Refer also to abstracts 29852 through 29855.

Energy Utilization and Economics

Refer also to abstracts 31790 and 31816.

32080 (AD-755222) SUPPORT OF ENERGY PROGRAM PLANNING. Final Report. Schmidt, R. A. (comp.) (Stanford Research Inst., Menlo Park, Calif.). Sep 1972. Contract N00014-72-C-0445. 256p. NTIS.

Principal energy problem areas of importance to the Department of Defense were identified and possible approaches to advanced research projects directed toward solutions of these problems were suggested to provide partial source material in support of ARPA's research program planning. Topics regarding sources and application of energy, energy transformation, storage, distribution, and energy utilization were included. For each topic, information was organized according to statement of the problem, state-of-the-art, present activities and organization, implications for the DOD, and recommendations for further studies. (NTIS)

32081 (ANL-8045) SOLAR ENERGY EVALUATION GROUP REPORT. (Argonne National Lab., Ill.). Aug 1973. Contract W-31-109-eng-38. 48p. Dep. NTIS $4.00.

A partial review of the status of various phases of solar-energy utilization and of some of the areas of potentially profitable research is reported. The review covers the biological and in vitro aspects of the photochemical conversion of solar energy; the photovoltaic, photothermal, and thermoelectric studies of the physical-conversion process; the use of solar energy for heating and cooling buildings; and the central-station power approach. (48 references) (auth)

32082 (BNL-18224) HYDROGEN ECONOMY. Sailor, V. L. (Brookhaven National Lab., Upton, N. Y.). 1973. 23p. Dep. NTIS $3.25.

A brief discussion was given of the possibilities of synthetic-fuel energy conversion cycles. The advantages and disadvantages of using coal and oil shale products were indicated. Environmental and economical problems remain during the production of synthetic fuels from coal and oil shale. Then the advantages and disadvantages of hydrogen as a synthetic fuel were outlined. Technical problems involve storage and on-board tankage for vehicles and aircraft. Safety problems were discussed. (MCW)

32083 (LA-5360-MS) FIELD AND CURRENT DISTRIBUTION IN COAXIAL SUPERCONDUCTORS. Clem, J. R. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

The magnetic-field and supercurrent distributions in coaxial superconductors are calculated and discussed. The inner conductor is a solid cylinder of circular cross section and the outer conductor is a coaxial cylindrical shell. Account is taken of both bulk and surface pinning. The distributions arising from a dc current in one direction down the inner conductor and returning through the outer conductor are treated in detail, including a discussion of the energy dissipation associated with flux motion. (auth)

32084 (LA-5377-MS) ECONOMICS OF SUPERCONDUCTING MAGNETIC ENERGY STORAGE SYSTEMS FOR LOAD LEVELING: A COMPARISON WITH OTHER SYSTEMS. Hassenzahl, W. V.; Baker, B. L.; Keller, W. E. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 20p. Dep. NTIS $4.00.

The capital costs of superconducting magnetic energy storage systems are calculated for various geometries, sizes, and support configurations. These are used as a basis for calculating, for a variety of operating conditions, the cost of delivered energy, which forms the basis of a comparison with other load-leveling systems. For certain configurations and operating conditions, superconducting magnetic energy storage is shown to be competitive with other load-leveling systems. (auth)

32085 (NBS-TN-789) TECHNICAL OPTIONS FOR ENERGY CONSERVATION IN BUILDINGS. Final Report. (National Bureau of Standards, Washington, D. C. (USA)). Jul 1973. 184p. GPO $2.00.

The report provides reference material on the technical options for energy conservation in buildings. It was prepared for the National Conference of States for Building Codes and Standards-National Bureau of Standards Joint Emergency Workshop on Energy Conservation in Buildings held at the U. S. Department of Commerce in Washington, D. C. on June 19, 1973. Actions described pertinent to existing buildings include summer cooling, winter heating, and other energy conserving features—i.e., insulation, fenestration, lighting, appliances, domestic hot water, and human comfort. Suggested actions include those that can be accomplished voluntarily or without expense, and also actions that require some modest effort or expense on the part of the building owner or occupant. Regarding new buildings, energy conservation actions are described that deal with building design and mechanical systems. (auth)

32086 (NBSIR-73-202) CONSERVATION VIA EFFECTIVE USE OF ENERGY AT THE POINT OF CONSUMPTION. Final Report. Berg, C. A. (National Bureau of Standards, Washington, D. C. (USA)). 11 Apr 1973. 37p. GPO.

The practices and equipment employed at the point of energy consumption in buildings and in industrial processes permit excessive consumption of energy. It is estimated that if full application of the economically justifiable technical improvements presently available were made to equipment and practices in buildings and industry, as much as 25% of the total primary fuel consumption in the U. S. A. could be conserved. The reasons why economically justifiable application of effective technology at the point of energy consumption has not been widely adopted in the past are considered. The needs to facilitate adoption of effective equipment and practices in the future are discussed. (auth)

32087 (NP-19853) SUMMARY REPORT OF ENGINEERING FOUNDATION CONFERENCE ON CONTROL STRATEGIES FOR POWER SYSTEMS HELD AT SOUTH BERWICK, MAINE, JULY 23-JULY 28, 1972. (National Science Foundation, Washington, D. C.). Nov 1972. 69p.

Increasing interconnection of electric power networks provides for contribution to the overall system reliability by permitting the sharing of the generating reserves during emergencies and the reduction of generating costs by allowing advantage to be taken of load diversity. Some drawbacks exist. The interconnection of power networks enables disturbances in one system to produce effects in other, sometimes remote, systems, sometimes resulting in cascading power failures. The conference embraced academic control experts who have evidenced interest in the possible applicability of newer analytical and synthesis techniques to power system control problems; capable power system engineers experienced in the objectives, constraints, and problems in the context of which their systems must be controlled; industrial experts conversant with the evolution and present state-of-the-art of power system control technology; academic theoreticians from related disciplines; and outstanding European authorities. The conference format involved sessions addressed by an authority on a given topic, followed by in-depth discussions. (MCW)

32088 (ORNL-NSF-EP-57) ENERGY USE FOR FOOD IN THE UNITED STATES. Hirst, E. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 46p. Dep. NTIS $4.50.

The energy used in food-related activities in the United States—from agriculture to final consumption—is computed for the year 1963 using energy Input/Output tables developed at ORNL and economic Input/Output data from the Department of Commerce. A total of 6,100 trillion Btu—12% of total 1963 energy consumption—was required to grow, process, transport, wholesale, retail, refrigerate, and cook food. This includes 190 billion kWhr, 22% of total electricity use that year. Farming accounted for less than one-fifth of the energy used for food. Farming and processing together used just over half the total. The remainder was used for transportation, trade, and household functions. Between 1960 and 1970, food-related energy use grew at an estimated 3.3% a year. This growth rate was greater than that for population but less than that for total energy use. On average, 6.4 Btu of primary energy were consumed in delivering one Btu of food energy to final demand. The comparable protein ratio was 840 Btu of primary energy per gram of food protein. (auth)

32089 (ORO-4398-1) SIMULATION AND EVALUATION OF MACROENERGETIC MODELS OF ENVIRONMENT, POWER, AND SOCIETY. Progress Report, September 1972–August 1973. Odum, H. T.; Zucchetto, J.; Searle, L.; Swallows, C.; Browder, J. (Florida Univ., Gainesville). 1973. Contract AT(40-10)-4398. 297p. Dep. NTIS $17.00.

This is an annual progress report on evaluation and simulation

of aggregated, simplified models of critical and large-scale aspects of the relationships of environment, energy, and economics with special attention to the major alternatives concerning energy sources and uses affecting the future balance of man and nature. (auth)

32090 (SLA-73-900) ECONOMIC COMPARISON OF TWO SOLAR/HYDROGEN CONCEPTS. McCulloch, W. H.; Pope, R. B.; Lee, D. O. (Sandia Labs., Albuquerque, N. Mex.). Oct 1973. Contract AT(29-1)-789. 12p. Dep. NTIS $3.00.

Two concepts for producing hydrogen from solar energy are examined. The utilization of solar energy and the concept of a hydrogen fuel both have drawbacks. Solar energy is intermittent, interrupted by the diurnal cycle of available sunlight and by weather conditions. Most systems designed to use solar energy include an expensive energy storage mechanism to meet demands during periods when there is no incident solar radiation. Hydrogen generation plants would require large amounts of energy input. The concepts described utilize parameters typical of operation in Albuquerque, New Mexico. It is assumed that the collectors are positioned with the axes in a northsouth plane, tilted 35° from the horizontal toward the south, with spacing between collectors equal to the collector dimensions. (MCW)

32091 GEOTHERMAL ENERGY SYSTEM. McCabe, B. C. (to Magma Energy Inc.). US Patent 3,757,516. 11 Sep 1973. Filed date 14 Sep 1971. 24p.

The method and apparatus for the nonpolluting generation of electrical power by the economic utilization of geothermal energy that is accessible through widespread sources of regenerative geothermal hot water are described. A well provides access to a geothermal hot water source having a temperature substantially above the flash point for atmospheric pressure, the hot water being conducted through heat exchangers wherein its heat energy is transferred to a power fluid employed in a closed Rankine heat engine cycle to generate electrical power, the water then being injected back into the aquifer. The geothermal hot water is pressurized by deep well pump means to a discharge pressure above its saturated vapor pressure for the source temperature, and a pressure gradient above the saturated vapor pressure is maintained through the heat exchangers, whereby the hot water is restrained from flashing into steam throughout its circuit, thereby avoiding any substantial temperature drop between the source and the heat exchangers and preventing release of any substantial mineral deposits at any point in the circuit. The very small expenditure of power required for such pressurization produces a large increase in total plant power output and efficiency by, among other things, (1) providing a top temperature power fluid Rankine cycle, (2) avoiding fouling of the well and surface equipment with mineral deposits, (3) deriving power from all of the geothermal fluid rather than just a stream fraction thereof, (4) allowing use of a power fluid that is particularly efficient in the available temperature range, and (5) avoiding degeneration of the power fluid source and ecological damage by returning the geothermal fluid to the aquifer. (Official Gazette)

32092 ENERGY OPTIONS. Bueche, A. M. (General Electric Research and Development Center, Schenectady, NY). J. Electrochem. Soc.; 120: No. 10, 295C-299C(Oct 1973).

Technical options available for use in solution of the energy crisis are reviewed. Discussions are included on sources and uses of energy with emphasis on electric power. Discussions are also included on fusion, magnetohydrodynamics, superconducting generators, potassium topping cycles, geothermal power, and storage and delivery of energy. (JRD)

32093 CATTLE MANURE TO PIPELINE GAS: A PROCESS STUDY. Feldmann, H. F. (Pittsburgh Energy Research Center); Kiang, K. D.; Wen, C. Y.; Yavorsky, P. M. Mech. Eng.; 95: No. 10, 36-41(Oct 1973).

The feasibility of supplementing the dwindling supplies of natural gas by the conversion of organic solid wastes to pipeline gas is examined. Not only does the disposal of these wastes constitute a major environmental problem and expense, they are the only renewable resource and their utilization will become more important as the natural resources become more scarce. A process is given for converting cattle manure to pipeline gas by direct hydrogasification. Economics of conversion is examined for two plant sizes, one for 690,000 lb/h of manure containing 30 percent moisture, and another of one-half this capacity. Gas prices, when averaged over a 20-yr plant life, are 41 cents/10^6 Btu for the large plant, and 57 cents/10^6 Btu for the smaller unit. These economics together with the economics of collecting and transporting the cattle manure, as well as the value assigned to environmental protection, will determine how widely this technology can be applied. (MCW)

32094 BOOSTING EFFICIENCY OF PERIMETER a/c SYSTEMS. Steixner, R. P. (Rockefeller Center, NY). Power; 117: No. 10, 48-49(Oct 1973).

Efficiency tests were performed in the McGraw-Hill building at New York's Rockefeller Center on induction units at perimeter areas. At perimeter offices, an induction unit has a circulation coil for hot water during the winter and for cold water during the summer. During spring and fall months the water may be either hot or cold, depending upon weather conditions. The coil has a control valve that is modulated by a local thermostat. The induction unit also received supply air, which creates a venturi effect or vacuum, pulling office air in the unit through the water-circulation coil. The system is limited to certain outside-air conditions, but could be used frequently during off-season months and even during summer dry days. The tests were performed on May 30, 1973 and July 6 and 13, 1973. (MCW)

32095 NUCLEAR AND OTHER ENERGY. Seaborg, G. T. (Lawrence Radiation Lab., Berkeley, CA); Bloom, J. L.; Nelson, E. L. Ann. N. Y. Acad. Sci.; 216: 79-88(18 May 1973).

Fossil fuels now supply over 95% of the U. S. commercial energy, and, even with a maximum effort to develop alternatives, the bulk of our cumulative requirements between now and the end of the century will have to be met from oil, gas, and coal resources. Nuclear, geothermal, and most other alternative forms of energy are restricted to a few specific uses, such as the generation of electricity. Consequently, fossil fuels cannot be replaced in many uses even after practical technologies to produce energy from other sources have been developed. There has been a serious effort to promote the use of nuclear fission for 25 years, and in 1971 it still accounted for less than one percent of the total U. S. energy supply. The National Environmental Policy Act of 1969 was designed as a statement of policy, but it also outlined certain procedures for all agencies of the government to follow. Courts have held that specific NEPA procedures are enforceable through suits of interested citizens. These cases brought to court have delayed the construction of vital facilities, especially electric power plants, and may contribute to energy shortages and other economic disruptions. (MCW)

32096 OFFSHORE DEEPWATER CRUDE-OIL TERMINALS. Mascenik J. (Esso Research and Engineering Co., Linden, NJ). Combustion; 45: No. 4, 7-14(Oct 1973).

Offshore deepwater crude-oil terminals appear to have favorable economic-benefit/cost ratios, and would possibly have the least effect on the ecology of a region. Single-point mooring (SPM) has been found particularly attractive for mooring very large crude carriers (VLCC) in moderate to severe sea and wind conditions. A new cluster concept is outlined along with the oil industry's effort to make SPM more reliable. Multibuoy moorings (MBM) are used at marketing, refining, and crude-loading terminals throughout the free world. SPMs are being used increasingly throughout the world at crude-loading and receiving terminals, especially since the advent of the VLCC. Single-point moorings are very common for mooring VLCCs. The types in use are the catenary anchor-leg mooring (CALM), the single anchor-leg mooring (SALM), SPM tower with rotating trussed arm (Brega, Libya), and SPM tower with floating hose (Fiumicina and Genoa, Italy). (MCW)

32097 ECONOMICS OF WET/DRY COOLING TOWERS FOR UTILITY POWER PLANTS. Klanian, P. S.; Noyes, E. G. Combustion; 45: No. 4, 31-34(Oct 1973).

The once-through cooling has proven to be the most economical method of rejecting waste heat from the steam power cycle. The scarcity of power plant sites with adequate once-through cooling water sources, the imposition of legal constraints on water use and discharge water quality, and the incentives for power plant siting at either the fuel source or the load center have dictated the use of supplementary cooling at most new locations. Basic supplementary cooling systems employed by the electric utility industry as alternatives to once-through cooling include man-made cooling lakes, spray canals, wet (evaporative) cooling towers of both natural and induced draft design, and dry (non-evaporative) cooling towers. The advantages of the combination wet-dry induced draft cooling towers include minimum plume effects, low water consumption, low evaluated costs, aesthetic appearance, maximum siteability, and effective cooling characteristics. Comparative evaluations are made with all methods of cooling. (MCW)

32098 CONTROLLING AMBIENT SO_2. Montgomery, T. L.; Leavitt, J. M.; Crawford, T. L.; Gartrell, F. E. J. Metals; 25: No. 6, 35-41(Jun 1973).

TVA developed a noncontinuous SO_2 emission limitation program for preserving local air quality around the Paradise Steam Plant during adverse dispersion conditions in 1966, and was begun in 1969. In September 1971, the second SO_2 emission limitation program was begun at the Widows Creek Steam Plant and in 1972, a third SO_2 emission limitation program was initiated at Cumberland Steam Plant. The programs have included continuing investiga-

tions into plume dispersions. TVA has been able to establish maximum ground-level concentrations and the location of associated impact areas at each of its power plants. Stack height requirements for the more recently built larger TVA power plants were influenced by the experiments. (MCW)

32099 SPRAY COOLING FIGHTS FOG BEST, SAYS DETROIT EDISON. Hoffman, D. P. Elec. Light Power, E/G Ed.; 51: No. 19, 32-36(Oct 1973).

The thermal performance and environmental effects of a floating spray module system were evaluated during a testing program from the fall of 1970 through June 1972. The test was run in the condenser discharge canal of the Enrico Fermi I plant. The nozzle flow rate, nozzle exit water temperature, and water temperature just prior to entering the canal were recorded simultaneously with meteorological conditions. A spray cooling canal can influence the local environment by adding sensible heat and water to the atmosphere. The sensible heat will cause the air temperature to rise on the downwind side of the canal, unlikely causing any adversity. The addition of water vapor is also unlikely to cause adverse effects. A study was made of fog prevention in the vicinity of the canal. (MCW)

32100 METHOD FOR PRODUCING A SOURCE OF ENERGY FROM AN OVERPRESSURED FORMATION. Hottman, C. E. (to Shell Oil Co.). US Patent 3,258,069. 28 Jun 1966. Filed date 7 Feb 1963. 8p.

A process is given for discovering and utilizing closed or isolated reservoir formations that contain aqueous liquids capable of releasing useful energy. The method may utilize energy provided by overpressured geological formations by recompleting a well into an overpressured water-bearing reservoir that had been encountered and sealed off when the well was initially completed or abandoned. Previous methods utilized energy sources at or near surface locations such as geysers or hot springs. This method utilizes aqueous liquid that is entrapped by undercompacted shale and has a pressure and temperature sufficient to yield useful energy. The invention is directed to a method for locating water useful as a feed stock for distillation plants in land areas where naturally occurring freshwater supplies are not capable of supplying the demand such as in the lower Gulf coast of the USA. A selected area of land in Texas was investigated to determine the distribution of undercompacted shale formations, reservoir formations, and temperature. The method is shown for generating electricity using either the pressure and/or temperature of the water produced. It is removed through a conduit and the pressure of the water used to operate a turbine. (MCW)

32101 APPARATUS FOR USING A SOURCE OF ENERGY FROM AN OVERPRESSURED FORMATION. Hottman, C. E. (to Shell Oil Co.). US Patent 3,330,356. 11 Jul 1967. Filed date 25 Feb 1965. 8p.

The design of an apparatus is given for providing the completion of a well in a closed or isolated reservoir formation containing aqueous liquids capable of releasing useful energy. The reservoir may be located below an undercompacted shale formation. Prior uses have been confined to operations within regions in which the energy from the underground sources is available at or near a surface location, especially regions containing natural hot springs and geysers. Examples of sources of energy found by the method include an area of land in Texas to determine the distribution of undercompacted shale formations, reservoir formations, and temperature and an area of land under the Gulf of Mexico for the determination of the same properties. The apparatus includes means for using the energy of the aqueous liquid to separate the aqueous liquid from the hydrocarbons contained in the reservoir liquid. (MCW)

32102 HYDROLOGY OF NEOGENE DEPOSITS IN THE NORTHERN GULF OF MEXICO BASIN. Jones, P. H. Louisiana Water Resources Research Institute Bulletin GT-2. Baton Rouge, LA; Louisiana State University (1969). 105p.

The Neogene deltaic and neritic marine deposits in the northern Gulf of Mexico Basin form regional aquifer systems in which pore pressures, salinities, and temperatures do not compare with those in older sedimentary basins. Rapidly buried sand and clay sequences, sealed off by growth faults, remain undercompacted and contain abnormally high fluid pressures (up to 0.96 times the overburden pressure). Such high pressures force saline formation water toward normally pressured aquifers. The intervening clay beds act like membrane filters to freshen the water, which subsequently dilutes the receiving aquifers. High pressures and trapped radiogenic heat cause diagenesis of montmorillonite to illite. The released fresh water of crystallization either remains in the transformed clay under high pressure, because the adjacent sand beds are already geopressured, or flows to and dilutes normally pressured aquifers. Osmotic pressures, generated by the membrane-like clays and which may be responsible for halting or even reversing these flows, are considered the dominant factor in the preservation of abnormal high pressures. Salinities vary from a few hundred to 300,000 mg/l at any depth below 6,000 feet. Generally decreasing salinities are evident below 12,000 feet. (auth)

32103 HYDRODYNAMICS OF GEOPRESSURE IN THE NORTHERN GULF OF MEXICO BASIN. Jones, P. H. (Geological Survey, Baton Rouge, LA). J. Petrol. Technol.; 803-810(Jul 1969).

An attempt is made to explain the phenomena of compression and compaction and the resistance to fluid expulsion associated with geopressure in Miocene and Pliocene deposits of the northern Gulf of Mexico Basin. Deltaic sediments and their prodelta and neritic equivalents were rapidly deposited and deeply buried. The montmorillonite content of these deposits ranged from about 50 to 80 percent or more. Contemporaneous faults compartmentalized sand-bed aquifers prior to escape of their interstitial saline water. Fluid pressure in compartmentalized reservoirs increased with deepening burial. Salinity of aquifer water increased where hyperfiltration by semipermeable clay beds concentrated dissolved solids in zones of water loss. Heating of the deposits accompanied deepening burial. Thermal dehydration of montmorillonite in a depth-related temperature zone with an average temperature of 221°F released some intracrystalline water as free pore water. Diagenesis of dehydrated montmorillonite (alteration to illite or chlorite) released remaining intracrystalline water. Dehydration and diagenesis of montmorillonite produced interstitial fresh water, markedly increasing effective porosity and permeability to fresh water, while markedly reducing the bulk density, load-bearing strength, and thermal conductivity of clay beds. Water flow upward from geopressured zones through clay beds in which dehydration and diagenesis of montmorillonite had occurred was accompanied by interstitial precipitation of cementing solids in the upper part of the clay bed, while the lower part of the same bed remained undercompacted and very soft to the drill. (42 references.) (MCW)

32104 NUCLEAR ENERGY AND ENVIRONMENT. Mattick, W. (Brown, Boveri und Cie AG, Mannheim, Ger.). (1973). vp. (In German).

From specialist meeting on energy supply and environmental protection as European tasks; Mannheim, Germany (18 Jun 1973).

Following a survey on the reasons for the increasing energy demand of man due to the growing necessities of life or the many levels of use expansion, the need for a greater application of nuclear energy is raised. The basic processes in the nuclear reactor, production and circuit of nuclear fuels as well as the resulting transport and costs problems are mentioned and compared with the case of conventional fuels (coal, oil). The arising dangers and thus required safety measures involved in producing nuclear energy are discussed. The present limitation and delay of nuclear technological construction plans and its licensing procedure in the FRG as well as the anxiety of the public to the building of new nuclear power plants are criticized. Industrial and organizing cooperation on a European basis is encouraged in the field of nuclear technology. (GE)

32105 ITALY'S FUEL FOR NUCLEAR FIRES. Salvetti, C. (Univ., Milan). Nucl. Active; 20-24(Jul 1973).

The demand for nuclear fuel is part of the growth of nuclear power. Italy has three nuclear power stations in operation: a 160 MWe gas cooled reactor at Latina, a 160 MWe BWR at Garigliano and a 250 MWe PWR at Trino. A fourth 850 MWe BWR station is under construction at Caorso (on the Po River) while the Government-owned utility, ENEL plans to place an order within the current year for a fifth large nuclear power station. Furthermore an increasing number of nuclear plants are envisaged in the mid-term future. Although slower than expected, the growth of nuclear power has catalyzed and influenced the start of nuclear fuel activities in Italy. On one side, the Government Agency for Nuclear Research, CNEN has started a number of projects aimed at helping the industry to acquire a nuclear fuel capability in the country, as independent as possible of foreign technologies; while on the other, the nuclear industry has taken steps to cope with short-term uranium fuel demands. The Italian Government makes the national decisions on nuclear policy, while CNEN, over and above its functions as the national regulatory authority on hazards, safety and nuclear matters in general, is designed to sponsor the nuclear industry. Development work in the field of nuclear fuel sponsored by CNEN and carried out with active industrial participation, is already well under way. In fact, CNEN now possesses an integrated capability for plutonium fuel design and fabrication, which constitutes an industrial asset. Moreover, a uranium reprocessing, fabrication and enrichment expertise has been acquired for the benefit of the nuclear industry to meet any possible future needs that may arise. (auth)

32106 ECONOMIC REPORT: INTERFUEL SUBSTITUTABILITY IN THE ELECTRIC UTILITY SECTOR OF THE U.S. ECONOMY. Staff Report to the Federal Trade Commission. Duchesneau, T. D. Washington, DC; Government Printing Office (1972). 87p. GPO $0.45.

The extent of interfuel substitution among the primary sources of energy in the electric utility sector of the economy is analyzed, and market boundaries are determined. Primary attention is given to assessing interfuel substitution within the electric utility sector. Once it is determined whether the various fuels trade in the same market or in different markets, it is possible to decide if oil company entry via acquisition into other fuels is properly viewed as an horizontal or conglomerate movement. Conceptually, competition is properly defined as encompassing both actual and potential competition. According to economic theory the determining factor in deciding whether products trade in the same or different economic markets is the degree of substitutability between products. Substitutability may be viewed either from the buyer's viewpoint, the demand side, or from the producer's perspective, the supply side. The cross-elasticity concept is generally considered as the proper means of measuring product substitutability. An important limitation is that economic theory does not indicate a priori the critical value of the cross elasticity coefficient which, if exceeded, allows the conclusion that products trade in the same economic market. Another limiting factor is that the cross-elasticity concept measures consumer or supplier response to changes in the prices of related goods and assumes that nonprice factors are stable. Substitutability, however, especially in terms of demand, is affected by nonprice factors. In addition to conceptual limitations, certain institutional features of the energy sector also reduce the usefulness of using cross elasticity coefficients to define market boundaries. Historical fuel use and costs indicate the extent of actual substitution between the fuels. The findings in all regions of the United States are discussed. (MCW)

32107 FEDERAL ENERGY CONSERVATION: AN INTERIM REPORT. Washington, DC; Department of the Interior (1973). 32p.

The Federal Government was directed to reduce energy consumption during Fiscal Year 1974 by 7%. More than eighty departments and agencies within the Federal Government consume nearly 3% of all the energy consumed in the Nation. It was determined that all eleven Cabinet-level Departments plus five independent agencies should receive the bulk of the attention because they own 97% of the Government's vehicles, occupy 99.7% of the Federal buildings both owned and leased, and employ 98% of all Federal personnel. The sixteen largest agencies consumed 2.26 quadrillion Btu of energy in Fiscal Year 1973, of which about 60% was for vehicle and equipment operations and about 40% for building and facility lighting, heating and cooling. The Department of Defense is by far the largest user of energy, consuming 85% of the total. Other large users are the AEC and GSA. Specific actions being taken to achieve the targeted reduction in energy use during the current fiscal year are described. (MCW)

32108 ENERGY AND THE ENVIRONMENT: ELECTRIC POWER. Washington, DC; Council on Environmental Quality (1973). 62p. GPO.

The elements underlying the growing demand for energy and the accompanying environmental implications are discussed. Chapter I discusses trends in the Nation's demand for energy and the supply systems for meeting this demand, pointing out the environmental damages resulting from energy use—air and water pollution, land degradation, and creation of solid wastes. Chapter II focuses on electric power and the environmental impacts of the fossil-fueled and nuclear systems, costs and effectiveness of various controls for these systems, and emerging technologies that have the potential for reducing these damages. Chapter III points out that improved efficiency of energy systems and energy conservation will reduce environmental damages and slow the use of energy resources. Chapter IV shows how electric demand forecasts can be combined with data on environmental impacts to yield an estimate of projected environmental consequences. (MCW)

32109 POWER PIPING TECHNOLOGY UPDATE. Schuster, R. Power Eng.; 77: No. 10, 33-37(Oct 1973).

The ideal power plant piping system provides the maximum efficiency and reliability at lowest cost. Problems exist now from the concept of the piping system to its completion. Fabricators' concerns range from the specifier's lack of practical knowledge in preparing specifications to interpretation of quality control tests, and involve disagreements on financial responsibility for repair work and attendant delays. Some specifications are impossible to meet, such as no wrinkling or flattening on pipe bends. Scheduling is experiencing unreal situations due to material shortages. Inspectors are unqualified and this is causing construction delays. Radiography and welding procedures are discussed. (MCW)

32110 ENERGY YEAR: 1973. Woods, W. P. Pub. Util. Fortn.; 92: No. 9, 17-19(25 Oct 1973).

The energy crisis was not a 1973 phenomenon for the gas industry. The greatest search in the industry's history was under way to find and develop new sources of gas. Reserves of gas for the 50 states have fallen during four of the past five years. In 1970 total reserves went up, reflecting the first inclusion of 26 trillion cubic feet of new gas in Alaska's North Slope. Over the past five years the U. S. has used twice as much gas as has been found. Geologists expect deposits of natural gas to be found under the far water areas bordering the U. S. coasts. Other than the proved and potential reserved in Alaska, a potential resource is locked in relatively impermeable rock formations in the western U. S. Experiments in nuclear fracturing to reach this gas are progressing. A major new source of gas may be developed from coal gasification. Other sources of new gas could be through the importation of liquefied natural gas and through the utilization of light hydrocarbon and crude oil feedstock for synthetic natural gas manufacture. (MCW)

32111 THREE-WAY SQUEEZE ON THE ENERGY CONSUMER. Bloom, G. I. Pub. Util. Fortn.; 92: No. 9, 28-30 (25 Oct 1973).

In 1967, an imbalance between energy shortages, rapid inflation, and popular interest in ecology occurred. If the energy shortage or the ecological cleaning-up processes had occurred and been solved in the early fifties when prices were low, the tasks of regulators would have been easier. All three phenomena occurred at the same time, and each had an effect on the other. The definitions of environmentalists and ecologists are explained. The collision is between two aspects of the environment—ecology and economy. Consumers do not understand that increasing the electric bills are connected to the environment—the cleaning up of the environment without any increase in electric power production. (MCW)

32112 GAS SUPPLY SITUATION. Pub. Util. Fortn.; 92: No. 9, 63-72(25 Oct 1973).

Some questions regarding the natural gas supply situations were presented to 14 executives of the gas industry. The accent in the coming year will be on fuel sufficiency, but the dominating concerns of the executives have been in the areas of supply, rates, and finance. The question on supply was: "What are your views about the outlook for improving the industry's natural gas supply for public distribution in the light of alternatives being suggested under pressure of the energy crisis, such as production incentives (foreign and domestic), FPC deregulation, additional curtailments and conservation measures, and the outcome of research and development in such areas as synthetic fuel and other substitutes?" Each executive presented his views. (MCW)

32113 PROBLEM OF INCREASING GAS RATES. Pub. Util. Fortn.; 92: No. 9, 74-76; 79(25 Oct 1973).

The executives of the gas industry answered a question on the gas rates at the Natural Gas Executives' Forum. The question was: "Assuming that higher-priced offshore supply as well as imports of natural gas and oil will be increasingly important factors in sustaining the public service supply available to customers of both the gas and electric utilities in the United States, what are your views either as to rolling in such increases into the prevailing rate structures subject to state and federal regulation, or otherwise accommodating them in the rate structure and overall revenue requirements?" Each executive presented his views. (MCW)

32114 ULTIMATE PROBLEM: FINANCING. Pub. Util. Fortn.; 92: No. 9, 80-83(25 Oct 1973).

The executives at the Natural Gas Executives' Forum answered a question on financing. "What are your views as to the prospects of the gas utilities in obtaining the necessary capital to meet plant requirements needed to fulfill their public service obligations in the months ahead, in the light of tight money, higher interest rates, and competitive demands in the money market?" The gas companies are no different from any other industry. Investors are attracted to an industry for a reasonable expectation of profitability. (MCW)

32115 CONVERSION SYSTEM FOR PROVIDING USEFUL ENERGY FROM WATER SURFACE MOTION. Richeson, D. T. US Patent 3,758,788. 11 Sep 1973. Filed date 14 Jun 1971.

An energy-conversion system is disclosed for converting water surface movement, e.g. wave motion, to useful energy. Buoyant structures are provided defining pairs of opposed surfaces affixed together by pivotal structures with energy means, e.g. bellows, held spaced-apart from the pivot means. In the disclosed embodiment, the bellows are actuated with displacements between the buoyant structures, to develop positive fluid pressures to accomplish various operations. As disclosed, a turbine is driven to motivate an electrical generator for providing electrical power through a conductor to an electrical load. (auth)

32116 COAL GASIFICATION PLANT BEGINS OPERATION. Chem. Eng. News; 51: No. 45, 21(5 Nov 1973).

The first commercial demonstration plant for converting coal to synthetic natural gas has begun operation at Westfield, Scotland, and is producing high calorific gas at a daily rate of 2.5 million ft^3 and at a cost estimated at 70 to 90 cents per million Btu of gas. At Westfield, too, is a separate study to see whether a variety of coals from different areas in the U. S. can be gasified with equal success in a Lurgi gasifier. A new market would open up for the vast coal reserves in the U. S., estimated to last for the next 500 years, if the commercially and technically viable process of converting coal to methane is successful. The demonstration unit at Westfield proves for the first time that the methanation can be carried out in a continuous operation using gas generated from a commercial grade of coal. Eastern and mid-western U. S. coal has been unacceptable in a Lurgi-type gasifier due to caking and swelling, but it is hoped that by changing the parameters of the operation, the coals can be made to gasify satisfactorily. Construction of large-scale commercial units in the U. S. capable of producing as much as 250 million ft^3 a day of the coal-derived natural gas would then be foreseeable. (MCW)

32117 DECONTROL: END OF A NOBLE EXPERIMENT. Moody, R. Jr. Pub. Util. Fortn.; 92: No. 9, 20-23(25 Oct 1973).

The wellhead price regulation of natural gas that has lingered for 19 years is discussed. Congressional reluctance to come to grips with natural gas regulation is becoming more disastrous each day. The level of service by pipelines is still dropping and the end is not in sight. The D. C. circuit court is evidently concluding that the Natural Gas Act does not permit the Federal Power Commission any power over producer rate matters. Commissioners have sought to make the producer regulation controls workable. Policy makers denounce any consideration of deregulation pointing out falsely that it is a gas industry proposal. The 5th circuit court of appeals states, "FPC has the statutory duty, not only to guard the consumers against super profits reaped from artificially inflated rates, but also to protect consumer interests by making sure that the rate schedule is high enough to elicit an adequate supply." (MCW)

Law

Refer also to abstract 30001.

Management

32118 (TID-26457) 1973 FINANCIAL REPORT. (Atomic Energy Commission, Washington, D. C.). 21 Sep 1973. 61p. GPO $0.95.

A ten-year (1964-1973) summary of net operating costs is first presented, including total and then breakout into the following: nuclear materials, weapons development and fabrication, civilian reactor development, physical research, other R and D, and other costs and revenues. Afterwards, operations are summarized under 16 separate activities, with a brief explanation of each and a financial comparison of 1973 vs 1972 for most of them. Financial statements include statement of operations, balance sheet, and the U.S. Government investment in the atomic energy program. Plant and equipment investment is summarized by type of facility and by location. Finally, investment statistics are tabulated according to: research and development centers, colleges and universities, prime industrial contractors, and geographical locations. (LMT)

32119 (UCRL-74825) ANATOMY OF A CONTINUING EDUCATION PROGRAM. Decker, W. D. (California Univ., Livermore. Lawrence Livermore Lab). 22 Jun 1973. 15p. (CONF-730725-1). Dep. NTIS $3.00.

From Engineering Foundation Conference; South Berwick, Maine, USA (1 Jul 1973).

A description is given of one department's experience with in-house continuing education. At the Lawrence Livermore Laboratory in California, the Mechanical Engineering Department responded to its unique problems of obsolescence. Continuing education is not a solution for every organization's search for maintaining competence. Each organization has its own particular circumstances and needs. LLL has achieved at least a qualified success with continuing education as a tool for maintaining the competence of engineers. (auth)

32120 EUROPEAN TECHNOLOGY. The Politics of Collaboration. Williams, R. New York; John Wiley and Sons, Inc. (1973). 221p. $13.00.

A preliminary analysis of European technological collaboration and the political and administrative problems that accompany such collaboration is presented. Efforts at technological cooperation both within the Common Market and without are considered with emphasis placed upon cooperation in the aerospace, nuclear, and computer fields. (JGB)

Mathematics and Computers

Refer also to abstracts 29852–29854, and 30411.

32121 (AAEC/E-262) IBM360 AND NOVA SOFTWARE DEVELOPED TO GIVE THE NOVA COMPUTER ACCESS TO THE RESOURCES OF THE IBM360 COMPUTER. Sanger, P. L.; Backstrom, R. P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1973. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

IBM 360 and NOVA software to allow NOVA programs stored as load modules on IBM 360 disk storage to be loaded directly into the NOVA computer via the Dataway, and to allow the contents of NOVA core storage to be sent to the IBM360 computer and listed on the IBM1403 line printer, is described. This software can be used as the basis for the development of software to allow other Dataway computers to access the IBM360 computer. A scheme for adding interactive programs to the normal IBM360 Jobstream by writing the necessary JCL and SYSIN data to the HASP internal reader is also presented. (auth)

32122 (AAEC/E-263) IBM360 AND NOVA SOFTWARE DEVELOPED TO ALLOW PLOTTER OUTPUT TO BE DISPLAYED ON THE TEKTRONIX T4002 GRAPHICAL DISPLAY TERMINAL. Backstrom, R. P.; Sanger, P. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1973. 76p. Dep. NTIS (U. S. Sales Only) $6.00.

The interaction of IBM 360 programs with the Tektronix T4002 Graphical Display terminal attached to the NOVA computer is described. These interactive facilities are used to allow plotter output from the IBM 360 computer to be displayed on the Tektronix Display Screen. Arbitrary sections of plots may be enlarged to any desired magnification for detailed viewing without the traditional "wrap-around" problem. This application is the first example of interactive computing using the AAEC Network and demonstrates the effectiveness of both the hardware and the software involved. (auth)

32123 (CEA-R-4454) COSYNUS, COMMAND LANGUAGE FOR THE C.A.R.I.N.E. SYSTEM CONTROLLING NEUTRON-DIFFRACTION EXPERIMENTS. Entressangle, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Sep 1973. 207p. (In French). Dep. NTIS (U.S. Sales Only) $12.50.

Thesis. Submitted to Grenoble Univ. (France). Faculte des Sciences.

The CARINE-software system (Computer Aided Research In Neutron Experiments) controls six neutron-beam experiments in a real-time environment. Control of all the apparatus and data acquisition are supported by a FORTRAN program which, using a library of standard functions, allows to communicate symbolically, by the way of the CAMAC dataway, with all the mechanical parts of the system. A user's FORTRAN program is activated using a time-sharing technique, so that every user's program seems to be running alone. The command language COSYNUS (COmmand SYstem for Neutron USers) allows the user to control his running FORTRAN program, which can be stopped, paused or restarted, and to activate a "display" unit on which data may be viewed in the form of graphs, these graphs being modified by a lot of display commands. The whole software system has been implemented on Telemecanique T 2000 Computer and contains three parts: COSYNUS, command system; SYSFOR, FORTRAN control system; GESCAM, CAMAC control system. Each of these parts is composed with a lot of modules running together under control of the RTDMS Real-Time Supervisor. The CARINE System is an original realization by: a Response time very brief; a Great Security; Automatic Reinitialization; Software Modularity; Optimization of memory place. (auth)

32124 (CONF-730937-1) COMMENTS ON HIGHER-ORDER TERMS IN MOMENTS OF MOMENTS, MOMENTS OF MAXIMUM-LIKELIHOOD ESTIMATORS, REGRESSION RESIDUALS. Shenton, L. R.; Bowman, K. O. (Georgia Univ., Athens. Computer Center; Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.). 1973. 25p. Dep. NTIS $3.25.

From international conference on asymptotic methods of statistics and their application on physical and social sciences; Prague, Czechoslovakia (18 Sep 1973).

Formulas for the n^{-2} biases and covariances of maximum-likelihood estimators in joint estimation are given. In addition,

an explicit expression is given for the maximum-likelihood estimator of a single parameter and functions thereof. A number of numerical illustrations of asymptotic moments are given, including a diversity statistic, estimators for the negative binomial, Neyman Type A, Hermite logarithmic series distribution parameters. (auth)

32125 (COO-1332-80) ANALYSIS OF RADIO-TRACKING DATA USING DIGITIZED HABITAT MAPS. Gilmer, D. S.; Miller, S. E.; Cowardin, L. M. (Northern Prairie Wildlife Research Center, Jamestown, N. D. (USA)). 1972. 11p. Dep. NTIS $3.00.

A method is described that provides a rapid and accurate analysis of habitat used by radio-equipped animals. The digitizer (basically an X–Y plotter in reverse) converts maps into digital form by describing each habitat unit as a polygon that closely approximates the actual shape of the unit. The coordinates of each polygon are then stored on magnetic tape. Habitat classification data and other information are coded and combined with the proper polygon coordinates. This results in one file containing all habitat data. A computer program with inputs of tracking data and habitat data provides a listing of the habitat used by the animals studied. Analysis of habitat used by radio-equipped ducks is demonstrated using this method. (auth)

32126 (IS-2895) PDP-15 UTILITIES MANUAL. Campbell, J. H.; Covert, G. F. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 154p. Dep. NTIS $9.75.

The various utility programs developed for use on a Digital Equipment Corporation PDP-15 computer are described. These programs were developed by the software systems group of the Ames Laboratory and are not supported in any manner by Digital Equipment Corporation. (auth)

32127 (KFK-PDV-3) DECISION TABLE PREPROCESSOR FOR CONTROL SYSTEMS (SYSTEMS DESIGN). Werthmann, R. (Kernforschungszentrum Karlsruhe (F. R. Germany)). May 1973. 80p. (In German). Dep. NTIS (U.S. Sales Only) $6.00.

The study deals with the design of a decision table preprocessor for process control systems. The range of possible applications for decision tables is shown, in particular, the conversion technique itself. Definite advantages are to be realized in the standardization and simplification of systems analysis, programming, and documentation. The conversion approach incorporates the matrix method and produces programs in the PEARL programming language. In accordance with the table criteria, a selection is made between the most applicable of two expression methods—bitstring or comparison operator. Through control parameters the decision table can be explicitly retained in matrix form (allowing table changes on-line). After thorough syntax and semantic description of the preprocessor input, the procedure is illustrated with two objective applications. (auth)

32128 (KFK-PDV-4) HARDWARE EXTENDED EXECUTIVE PRIMITIVES FOR PROCESS CONTROL SYSTEMS. Nehmer, J. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Datenverarbeitung in der Technik). May 1973. 20p. (In German). Dep. NTIS (U.S. Sales Only) $3.00.

This report describes on the basis of a layer structure for process control software, the subdivision of the operating system nucleus into classes of executive primitives which may be called by interrupt routines. (auth)

32129 (KFK-PDV-5) PERFORMANCE CHARACTERISTICS OF TODAY'S PROCESS CONTROL COMPUTERS. Herbstreith, H.; Kossman, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). Jun 1973. 36p. (In German). Dep. NTIS (U.S. Sales Only) $4.00.

The state of the art in modern process computers is reviewed. For this purpose a representative selection of 19 American and European process computers was examined. The most important characteristics of the central processor units have been determined and a comparative overview is given including a discussion of performance data and their statistical distribution. By an additional investigation of 256 process computers operating during the past 7 years trends in the development of hardware features such as word length, cycle time, instruction set, and addressing modes are shown. (auth)

32130 (LA-5356-T) METHOD OF MOMENTS APPLIED TO AN INVARIANT-IMBEDDING SOLUTION OF A CERTAIN CLASS OF FREDHOLM INTEGRAL EQUATIONS. Boicourt, G. P. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 127p. Dep. NTIS $5.45.

Thesis. Submitted to Univ. of New Mexico, Albuquerque.

A method is developed for solving the Fredholm integral equation when $\gamma(z')$ is a constant and then extends it to the case where $\gamma(z')$ is a step function. The solution of the integral equation is achieved by solving the integro-differential invariant-imbedding equations derived from the integral equation by varying the limits of integration. The imbedding equations are solved using a moment method that reduces the calculation to an initial-value problem. Proofs of the existence and convergence of the method are given. In the case where $\gamma(z')$ is a constant, the solution of the integral equation is obtained by a simple quadrature of the product of the solution with a transform of the function $g(z)$. In the case where $\gamma(z')$ is a step function, the integro-differential equations for the reflection and transmission kernels are reduced to initial-value problems and solved. These kernels are used to obtain fluxes from which the solution to the integral equation can again be obtained by simple quadratures. Numerical examples are presented. (auth)

32131 (ORNL-TM-4377) MANYFILE: A COMPUTER PROGRAM FOR USE IN THE MANIPULATION OF DATA SETS BETWEEN VARIOUS INPUT/OUTPUT DEVICES. Comolander, H. E.; Gryder, R. K. (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

MANYFILE is a utility program written in PL1 Language, designed to manipulate, in one job step, one or numerous data sets (files) of information from/to various storage media. A data set to be processed can be located on any device and can be transferred to any other device. Therefore, the program can be used for card-to-tape, tape-to-tape, tape-to-printer, tape-to-disk, disk-to-tape, or any combination of operations. Either 7-track or 9-track tapes can be processed. MANYFILE automatically lists on SYSPRINT the first 30 records of each data set that is processed and prints out the total number of records (logical) in each data set. (auth)

32132 (SLA-73-894) CHILES: A FINITE ELEMENT COMPUTER PROGRAM THAT CALCULATES THE INTENSITIES OF LINEAR ELASTIC SINGULARITIES. Benzley, S. E.; Beisinger, Z. E. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 48p. Dep. NTIS $4.50.

CHILES is a finite-element computer program that is used to calculate the strength of singularities in linear elastic bodies. A generalized quadrilateral finite element that includes a singular point at a corner node is incorporated in the code. The displacement formulation is used and interelement compatibility is maintained so that monotone convergence is preserved. Plane stress, plane strain, and axisymmetric conditions are treated. Crack tip singularity problems are solved by this version of the code but any type of singularity may be properly modeled by modifying selected subroutines in the program. (auth)

32133 (UCID-30067) ALA76: ALGOL ADAPTED TO THE 7600. Ranelletti, J. E.; Zosel, M. E.; Zucconi, L.; Zwakenberg, R. G. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Aug 1973. Contract W-7405-eng-48. 37p. Dep. NTIS $4.00.

ALA76, an ALGOL-like language designed for use on the CDC 7600, is described. The language syntax is similar to that of Burroughs Extended ALGOL with some influence from ALGOL 68 control structures. Semantic restrictions and extensions reflect the CDC 7600 hardware and requirement that ALA76 procedures be compatible with other languages. These include an expanded operator set and elimination of recursion. (auth)

32134 (UCID-30071) FORMULATION OF THE BOUNDARY CONDITIONS FOR THE TENSOR CODE. Kishi, T. (California Univ., Livermore. Lawrence Livermore Lab.). 13 Sep 1973. Contract W-7405-eng-48. 43p. Dep. NTIS $4.25.

The boundary calculations are made of array and vector processors contained in the two-dimensional TENSOR code. To find a more effective computational procedure for the Illiac IV array processor, it was necessary to reconsider the original boundary conditions and apply them to the boundary points as if they were ordinary points. New array structures and data strategies were necessary to apply the techniques. (auth)

Miscellaneous

32135 (AEC-tr-7447) EXPERIMENTS ON CHEMICAL DEGASSING OF FEED WATER FOR STEAM GENERATORS. Brandel, A. Translation of pp 6-7 from the VGB Feedwater Conference, Essen, Germany, 1970. 5p. Dep. NTIS $3.00.

Results of tests conducted to estimate the influence of hydrazine on dissolved oxygen in boiler feed water are presented. Test results show that whether activated or not, hydrazine does not appear to have a marked effect on oxygen removal in steel preheater loops. However, the influence of oxygen removal can be clearly detected in a power plant with a low-pressure preheater line of copper

alloy. Oxygen disappears in the preheater line in all cases whether hydrazine is added or not. (JRD)

32136 (AEC-tr-7455) NEW THEORY FOR THE EVALUATION OF TESTS OF THE NATURAL WATER CIRCULATION IN STEAM BOILERS. Zinzen, A.; Schubert, F. Brennst.-Waerme Kraft; 10: 216-218(1958). 9p. Dep. NTIS $3.00.

After observations of gas bubbles rising in water had demonstrated that these directly entrain considerable quantities of water, a new theory was formulated for the evaluation of water circulation tests in which this phenomenon is taken into account. It thus becomes possible to reconcile the tests published by different authors at least in qualitative manner and to interpret the anomalies which were observed. (auth)

32137 (AEC-tr-7460) PROBLEM OF STRESS CORROSION OF HOMOGENEOUS SOLID SOLUTIONS. VIII. Problems of Stress Corrosion Susceptibility in the Copper–Nickel System. Graf, L.; Lacour, H. R.; Richter, W.; Wittich, W. Translated from Z. Metallk.; 54: No. 7, 406-416(1963). 24p. Dep. NTIS $3.25.

Stress corrosion susceptibility of solid solutions of Cu–Ni systems in acids, bases, metal chlorides, metal nitrates, and metal sulfides was studied. Results are presented in tables and diagrams.

32138 (AERE-R-7256) FABRICATION AND PROPERTIES OF MAGNESIUM–CARBON FIBRE COMPOSITES. Minty, D. C.; Old, C. F. (Atomic Energy Research Establishment, Harwell (England)). Jul 1973. 20p. Dep. NTIS (U.S. Sales Only) $3.00.

Composite materials have been prepared by the extrusion of encapsulated Mg and Mg–13 wt % Al powders mixed with chopped carbon fibers. Tensile strength and Young's modulus have been measured and correlated with fabrication route and the resultant structure. The best composites showed large increases in the Young's modulus but the fracture stress remained similar to that of the unreinforced material. (auth)

32139 (AERE-R-7450) AIR-COOLED HEAT EXCHANGER PERFORMANCE SPECIFICATION. Rose, J. C.; Wilson, D. J.; Cowan, G. H. (Atomic Energy Research Establishment, Harwell (England)). Jun 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00. UK 50 pence.

The specification gives guidance with respect to air-cooled heat exchanger location, design ambient temperatures, fan and plenum configuration, fan and drive selection, general process considerations, thermal performance, measurement of airflow, and noise levels from air-cooled exchangers. It is intended to be complementary to API Standard 661 "Air-Cooled Heat Exchangers for General Refinery Services". (auth)

32140 (BDX-613-909) CABLE FABRICATION AND ENCAPSULATION PROCESS IMPROVEMENTS, FY73-3. Quarterly Report. Husby, T. J. (Bendix Corp., Kansas City, MO). Jul 1973. Contract AT(29-1)-613. 15p. Dep. NTIS $3.00.

Methods were developed to apply solder sleeves to five common types of cable terminations. Studies revealed that TFE Teflon, RTV630, and Sylgard 186 molding materials can be used with EN-4 polyurethane. Significant cost savings can be realized through use of the Cable Identification Device. (auth)

32141 (BDX-613-910(Rev.)) IMPROVED DENSITY CONTROL OF MOLDED DESICCANTS. Conway, J. M. (Bendix Corp., Kansas City, MO). Aug 1973. Contract AT(29-1)-613. 16p. Dep. NTIS $3.00.

A process was initiated which is used to evaluate the effects of using flexible tooling in the cold pressing of molded desiccant billets. Significant improvements in billet uniformity resulted from the use of the flexible tooling regardless of billet thickness or mold loading techniques. (auth)

32142 (BDX-613-972) ORBITAL HEADFORM STAKING APPLICATIONS FOR MINIATURE ELECTROMECHANICAL ASSEMBLIES. Elder, C. W. Jr. (Bendix Corp., Kansas City, MO). Aug 1973. Contract AT(29-1)-613. 11p. Dep. NTIS $3.00.

A riveting method known as orbital headforming or "noiseless riveting" was investigated for potential application in the assembly of miniature electromechanical components. In this process, the punch contacts only a small area of the part at any time. Consequently, staking or swaging can be achieved with small tool pressures and minimum distortion of the part's grain structure: small delicate parts or parts of brittle materials (ceramic or plastic) used in electromechanical assemblies can be swaged or staked by this method. Sample parts were tested which simulated rivet and pin configurations, sizes, and materials found in miniature electromechanical devices. Most of the tests were successful. With refinements, orbital riveting would be a useful assembly method. (auth)

32143 (BNL-17977) FIELD MEASUREMENT OF RATES OF OXIDATION OF SO_2. Manowitz, B.; Newman, L. (Brookhaven National Lab., Upton, N. Y.). Jun 1973. 9p. (CONF-730720-2). Dep. NTIS $3.00.

From technical conference on observation and measurement of atmospheric pollution; Helsinki, Finland (30 Jul 1973).

Measurements were made of the rates of oxidation of SO_2 in coal (Keystone Station of Pennelec Co., Indiana, Penn.) and oil (Northport Station of Lilco, Northport, N.Y.) fired plumes for distances up to 20 kilometers by direct measurement of SO_2 and sulfate concentrations, measurement of the ratio of SO_2 to SF_6 (injected in the stack gases), and measurement of the isotopic ratio of ^{32}S to ^{34}S in plume SO_2. An analysis of the results is included along with tabulated data obtained in a typical run. (JRD)

32144 (BNL-18053) SOME FURTHER OBSERVATIONS OF SOFT PHONON LINE SHAPES IN $KMnF_3$. Shapiro, S. M.; Axe, J. D.; Shirane, G.; Riste, T. (Brookhaven National Lab., Upton, N. Y.). 1973. 8p. (CONF-730464-3). Dep. NTIS $3.00.

From NATO advance study institute conference; Ustaoset, Norway (24 Apr 1973).

Observation of a central peak associated with the phase transition at $T_c^M = 90°K$ in $KMnF_3$ where a Phonon at the M point $(0\ 1/2\ 1/2)$ becomes soft is reported. Attempts to measure a line width of the central peak are discussed. (JRD)

32145 (BNL-18054) QUALITATIVE PICTURE OF THE TRICRITICAL POINT. Blume, M. (Brookhaven National Lab., Upton, N. Y.). 1972. 9p. (CONF-730464-2). Dep. NTIS $3.00.

From NATO advance study institute conference; Ustaoset, Norway (24 Apr 1973).

It is noted that in liquid–gas transitions, if the two phases differ from one another by symmetry, as in the paramagnetic–ferromagnetic transition in the absence of an external field, it is possible in principle to determine in which of the two phases the system exists. A line of first-order transitions can change into a line of second-order transitions. Studies of the changeover point show that from a thermodynamic view this point is in reality the intersection of three lines of critical points. An introduction to tricritical phenomena is presented. (JRD)

32146 (BNL-18105) FORM FACTOR IN Fe AT SMALL WAVEVECTORS BY MAGNETIC INELASTIC SCATTERING OF NEUTRONS. Shirane, G.; Als-Nielsen, J. (Brookhaven National Lab., Upton, N. Y.). 1973. 7p. (CONF-730821-3). Dep. NTIS $3.00.

From international conference on magnetism; Moscow, USSR (22 Aug 1973).

Bragg scattering data for f(Q) in Fe has previously been interpreted by assuming a magnetic moment distribution from 3d electrons carrying 2.39 μ_B/atom superimposed on an oppositely polarized sea of 4s electrons carrying −0.21 μ_B/atom. Observations of this were made by comparing the inelastic critical scattering around the forward direction with that around the (1,1,0) Bragg point using the 3-axis crystal spectrometer in the constant Q mode of operation. It was found that the form factor is larger than unity at small Q having an approximately constant value of 1.06 for .05 $Å^{-1} \leq Q \leq 0.17\ Å^{-1}$. In addition, the unusual focusing effects in small angle inelastic scattering has revealed a central peak in the ω-spectrum slightly below T_c which is interpreted as being the first observation of longitudinal critical fluctuations in Fe. (auth)

32147 (BNL-18139) EFFECT OF CYCLOPHOSPHAMIDE ON KINETICS OF THORACIC DUCT LYMPHOID CELLS AND BLOOD LEUKOCYTES OF CALVES. Wagner, H. P.; Troxler, M.; Cottier, H.; Chanana, A. D.; Cronkite, E. P.; Joel, D. D. (Bern Univ. (Switzerland); Brookhaven National Lab., Upton, N. Y.). [nd]. 14p. (CONF-731005-1). Dep. NTIS $3.00.

From 13th Hanford biology symposium on the cell cycle in malignancy and immunity; Richland, Washington, USA (1 Oct 1973).

The effect of a single intravenous dose of cyclophosphamide (20 mg per kg body weight) on the cellular output, mitotic index, labeling intensity and pyknotic index of thoracic duct lymphocytes was investigated. The output of proliferating large thoracic duct lymph cells was reduced to approximately one-third of pretreatment values within 2 days. The numbers of large mononuclear cells, small lymphocytes, and neutrophils in blood decreased, reaching minimum values within 2, 3-5 and 7 days, respectively. The most important numerical reduction was observed in neutrophils. Although the effect of immunosuppressive agents on humoral and cellular immune responses has been studied in detail, little is actually known about the cytokinetic effects of these agents on normal lymphoid cells. Therefore, a detailed study of the cytokinetic effects of a single intravenous (i.v.) dose of

cyclophosphamide (CYT) on proliferating and resting bovine thoracic duct lymph (TDL) and blood leukocytes was performed. Results of this investigation are presented. (LMT)

32148 (CALT-822-53) MAGNETIC AND ELECTRICAL PROPERTIES OF AMORPHOUS Pd–Co–P ALLOYS. Marzwell, N. I. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Sep 1973. Contract AT(04-3)-822. 42p. Dep. NTIS $4.25.

The magnetic properties of Pd–Co–P alloys show that they are ferromagnetic, with a Curie temperature between 272 and 399°K as the cobalt concentration increases from 15 to 50 at.%. Below 20 at.% Co the short-range exchange interactions which produce the ferromagnetism are unable to establish a long-range magnetic order and a peak in the magnetization shows up at the lowest temperature range under an applied field of 6.0 kOe. Electric-resistivity measurements were performed from liquid helium temperature up to the vicinity of the melting point (900°K). The electric resistivity of Pd–Co–P shows the coexistence of a Kondo-like minimum with ferromagnetism. The minimum becomes less important as the transition metal concentration increases and the coefficients of $\ln T$ and T^2 become smaller and strongly temperature dependent. The spin ordering in these kinds of alloys can be simulated as the ordering due to an applied external field or as an increase in internal fields, due to an increase in transition-metal concentration. The negative magnetoresistivity is a strong indication of the existence of localized moments. (auth)

32149 (CEA-CONF-2243) CHARACTERIZATION BY CHEMICAL MEANS AND BY X-RAY TOPOGRAPHY OF THE DEFECTS APPEARING AT THE TIME OF THE DIFFUSION OF PHOSPHORUS IN SILICON. Mortini, P.; Rolland, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 17 Oct 1972. 23p. (In French). (CONF-720990-9). Dep. NTIS (U. S. Sales Only) $3.25.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semiconductors; Grenoble, France (27 Sep 1972).

32150 (CEA-CONF-2276) APPLICATION OF VIBRATORY METHODS TO THE DETERMINATION OF THE ELASTIC CHARACTERISTICS OF ISOTROPIC MATERIALS OR MATERIALS HAVING A RECTANGULAR HETEROTROPY. Bourgain, L.; Samson, G.; Boulegue, D. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 27p. (In French). (CONF-730218-1). Dep. NTIS (U. S. Sales Only) $3.50.

From meeting on the propagation of vibrations; Grenoble, France (1 Feb 1973).

32151 (CEA-CONF-2312) DUPLEXERS WITH TWO-DIMENSIONAL GUIDES AND APPLICATION TO MILLIMETER POLARIMETRY. Mendonca, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 18p. (In French). (CONF-730551-3). Dep. NTIS (U. S. Sales Only) $3.00.

From first French-Spanish colloquium on microwaves meeting; Madrid, Spain (21 May 1973).

32152 (CEA-R-4412) FURTHER DEVELOPMENTS IN THE STUDY OF HARMONIC ANALYSIS BY THE CORRELATION AND SPECTRAL DENSITY METHODS, AND ITS APPLICATION TO THE ADULT RABBIT EEG. Meilleurat, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jul 1973. 152p. (In French). Dep. NTIS (U.S. Sales Only) $9.75.

32153 (CEA-R-4459) CONTRIBUTION TO THE STUDY OF HYDROGEN IN METALS: INVESTIGATION, BY THE INTERNAL FRICTION TECHNIQUE, OF THE INTERACTIONS BETWEEN HYDROGEN ATOMS, AND DISLOCATIONS IN FACE CENTERED CUBIC METALS. Renard, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug 1973. 100p. (In French). Dep. NTIS (U.S. Sales Only)) $7.00.

Thesis. Submitted to Lyon Univ. (France).

In the range 77 to 300°K, internal friction of hydrided nickel and copper is investigated by the means of an inverted torsion pendulum which allows thermomechanical treatments (such as annealing, hydrogen loading from the vapor phase, and cold-working) to be performed in situ. Hydrogen-loaded specimens cold worked at low temperatures ($T < 77$°K) exhibit, when warmed up, a dislocation pinning stage (in the range 110 to 170°K for Ni and in the range 150 to 200°K for Cu). The kinetics of pinning, studied in the case of nickel, have shown the interaction between hydrogen and dislocations to be a long-range effect. If the hydrogen content is high enough, the pinning stage is followed by an internal friction peak called M at 235°K. A comparison between both systems Fe–N and Ni–H leads to identification of M with the KOSTER peak that can be observed in body-centered metals. With copper containing 5×10^{-6} hydrogen atoms a relaxation peak called P_H is observed at 150°K. An experimental study of this peak has been carried out. It suggests P_H to be due to the thermomechanical breakaway of dislocations pinned by hydrogen atoms. (auth)

32154 (CEA-R-4462) THEORETICAL STUDY OF RELATIONS BETWEEN STRUCTURE AND PHYSICO-CHEMICAL PROPERTIES IN THE NITROXIDES AND KETYL SERIES. Ellinger, Y. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Aug 1973. 342p. (In French). Dep. NTIS (U.S. Sales Only) $19.25.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

Calculations are made for the aminoxy, ketyl, and iminoxy free radicals. Molecular geometry of H_2NO, H_2CO^-, and H_2CNO was determined. (DLC)

32155 (CNRS-CPT-73-P-545) SOME OTHER EXAMPLES OF RETURN TO EQUILIBRIUM FOR FERMI SYSTEMS. Ferrero, P.; de Pazzis, O. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). Jun 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

The problem of return to equilibrium of a Fermi system is considered in the case of some unbounded perturbations of the Hamiltonian, namely those due to reflecting rigid boundaries. (FR)

32156 (CONF-710501-P2, pp 709-720) DISTRIBUTION OF Zn, Fe, Mn, AND Sr IN MARINE FISHES OF DIFFERENT FEEDING HABITS. Ting, R.Y. (Puerto Rico Nuclear Center, Mayaguez) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

32157 (CONF-710501-P2, pp 769-775) CONCENTRATIONS OF MANGANESE, IRON, AND ZINC IN JUVENILES OF FIVE ESTUARINE-DEPENDENT FISHES. Cross, F. A.; Brooks, J. H. (National Marine Fisheries Service, Beaufort, NC) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

32158 (CONF-710501-P2, pp 836-839) TRACE ELEMENTS IN MARINE SHRIMP. Knauer, G. A. (Hopkins Marine Station, Pacific Grove, CA); Harriss, R. C.; Glooschenko, W. A. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

32159 (COO-1112-146) REGULARITY IN THE CRITICAL PHENOMENA. Tomozawa, Y. (Michigan Univ., Ann Arbor. Dept. of Physics). Apr 1972. 12p. Dep. NTIS $3.00.

It is pointed out that a thermodynamical constraint for critical phenomena, combined with the scaling law, leads to sets of critical exponents, one of which agrees with the present experimental data reasonably well. (auth)

32160 (COO-1714-7) SOLID-STATE ELECTRICAL PROPERTIES OF PROTEINS AND BIOLOGICAL SYSTEMS. Technical Progress Report, February 21, 1970–August 15, 1973. Rosenberg, B.; Kemeny, G. (Michigan State Univ., East Lansing. Dept. of Biophysics). 1973. Contract AT(11-1)-1714. 19p. Dep. NTIS $3.00.

32161 (COO-2128-4) POSITRON LIFETIME MEASUREMENTS AS A NONDESTRUCTIVE TECHNIQUE TO MONITOR FATIGUE DAMAGE. Final Progress Report, January 1, 1972–December 31, 1972. Byrne, J. G. (Utah Univ., Salt Lake City. Div. of Materials Science and Engineering). Jul 1973. Contract AT(11-1)-2128. 53p. (UTEC-MSE-73-124). Dep. NTIS $4.75.

Activities in the second year of effort on applying measurements of positron-lifetime distributions to characterize plastic deformation are described. The critical parts (electronics in the base of the photomultipliers) of the electronics have been brought under temperature control of within ±0.1°C thus minimizing drift problems. In data analysis a computer program is functioning in which there are no fixed experimental parameters. This permits much more accurate results. Samples of pure Ni and a Ni–65% Co alloy have been fatigued to failure. Positron lifetime and x-ray particle size were measured at various fatigue lives and transmission electron microscopy was performed after failure. Good correlation was found between the three techniques and it appears

that positron lifetime can be used as an effective tool to study fatigue mechanisms. (auth)

32162 (COO-3631-1) EXPERIMENTAL STUDIES OF CRITICAL POINT BEHAVIOR IN MAGNETICALLY ORDERED SOLIDS USING NUCLEAR GAMMA-RAY SPECTROSCOPY, AND RELATED EXPERIMENTS. Annual Progress Report, November 1, 1971–October 31, 1972. Hohenemser, C. (Clark Univ., Worcester, Mass. (USA). Dept. of Physics). 1972. 6p. Dep. NTIS $3.00.

Research on critical fluctuations is described. Included are theoretical calculations relating perturbed angular correlation measurements on RhNi to neutron-scattering data on Ni; experiments on RhNi and FeNi above the critical point; and aspects of the experimental apparatus. (auth)

32163 (COO-3631-2) INTERPRETATION OF CRITICAL FLUCTUATIONS IN RhNi AND Ni. Technical Report I. Hohenemser, C.; Gottlieb, A. (Clark Univ., Worcester, Mass. (USA). Dept. of Physics). [nd]. Contract AT(11-1)-3631. 3p. (CONF-720998-2). Dep. NTIS $3.00.

From conference on perspectives for hyperfine interactions in magnetically ordered systems; L'Aquila, Italy (11 Sep 1972).

On the basis of time differential perturbed angular correlation experiments in RhNi it is argued that dynamic scaling appears to be violated in this system. (auth)

32164 (COO-3631-4) INTERPRETATION OF CRITICAL FLUCTUATIONS IN FeNi. Technical Report II. Gottlieb, A.; Hohenemser, C. (Clark Univ., Worcester, Mass. (USA). Dept. of Physics). [nd]. Contract AT(11-1)-3631. 3p. (CONF-720998-1). Dep. NTIS $3.00.

From conference on perspectives for hyperfine interactions in magnetically ordered systems; L'Aquila, Italy (11 Sep 1972).

On the basis of Moessbauer linewidth experiments in FeNi it is argued that understanding of critical fluctuations in this system is incomplete. (auth)

32165 (FRNC-TH-395) HALOGENATED COMPLEXES OF GADOLINIUM AND LANTHANIDES. Nephelauxetic Effect. Moulin, N. (Paris-6 Univ., 75 (France)). 1972. 71p. (In French). Dep. NTIS (U.S. Sales Only) $5.75.

Thesis.

Data concerning the complexing of M^{3+} lanthanide ions are recalled together with the thermodynamic consequences of the nephelauxetic effect. The experimental research concerned the complexing of trivalent lanthanides: Sm, Eu, Gd, Tb, and Dy with Cl^-, Br^-, I^-, and NO_3^-. The formation constants were determined by solvent extraction. These constants are deduced from the coefficients of distribution obtained by γ radiometry, the rare earths being labeled with neutron irradiation. The values measure in this way for ΔG, ΔH, and ΔS demonstrate that the ML^{2+} complexes are complexes with an outer sphere of coordination ($\Delta H < 0$ and $\Delta S < 0$) and that the complexing tendency is as follows: $Cl^- < Br^- < I^- < NO_3^-$. The ligands can be classed as follows $NO_3 < Cl$ or $Br < I$ for the nephelauxetic effect. (FR)

32166 (GKSS-71/E/20) PREPARATION AND CHARACTERIZATION OF ASYMMETRIC CELLULOSE ACETATE MEMBRANES. Boeddeker, K. W.; Kaschemekat, J. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Hamburg (West Germany)). 1971. 32p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

32167 (IS-T-598) EPR STUDY OF W^{+5} IN TRICLINIC $Na_{0.33}WO_3$. Mollet, H. F. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 165p. Dep. NTIS $10.25.

Thesis.

The design and construction of an X-band EPR cavity coaxial cable assembly is described. It operates in the temperature range 300 to 3°K and allows changing samples at any temperature. The EPR study of W^{+5} in triclinic $Na_{0.33}WO_3$, a recently discovered compound, has been carried out at about 15°K and 9.2 MHz. The EPR spectrum consists of two strong resonances and several weaker resonances whose relative intensities are sample dependent. The total W^{+5} concentration is approximately 1000 at. ppM. The principal g-tensor components and the ^{183}W hyperfine splitting constants for the two strong resonances are tabulated. It is proposed that the observed resonances are due to different W^{+5} point defects in the $Na_{0.33}WO_3$ host. This work represents the first evidence of W^{+5} in the tungsten bronzes. (auth)

32168 (JUL-965-TP) COMPUTER PROGRAM FOR PLOTTING LAUE REFLECTION PATTERNS AND ITS APPLICATION FOR CRYSTAL ORIENTATION IN ESR-SPECTROSCOPY. Preuss, E.; Pieper, H. H. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Technische Physik). Jun 1973. 72p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

A computer program for plotting Laue reflection patterns described previously by one of the authors has been modified for the case of Laue transmission patterns. These patterns can be plotted for any desired crystallographic direction. By comparing the Laue pattern of the single crystal with a computed and plotted pattern, the crystal orientation can be easily determined. One application of this method is the orientation of single crystals in principal directions for paramagnetic resonance experiments. The experimental setup for low temperature ESR measurements with commercially available cavities and the transfer device are described. (auth)

32169 (JUL-967-RG) FUNDAMENTALS OF THERMOCHEMICAL CYCLIC PROCESSES. Barnert, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Jun 1973. 68p. (In German). Dep. NTIS (U.S. Sales Only) $5.50.

Relations between heat and work and thermodynamic data of chemical reactions are given. They are derived with the theory of the thermodynamic of irreversible processes using a number of homogeneous regions. There are considered several sorts of entropy production and their effects on the efficiency. Hereby statements are possible on thermochemical cyclic processes, especially on the thermochemical cyclic process for the production of hydrogen and oxygen from water. (auth)

32170 (KFK-1805) INVESTIGATIONS OF THE SINTERING BEHAVIOUR AND THE MECHANICAL AND ELECTRICAL PROPERTIES OF Al_2O_3 WITH ZnO AND NiO ADDITIVES AT HIGH TEMPERATURES. Dilger, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). May 1973. 139p. (In German). Dep. NTIS (U.S. Sales Only) $9.00.

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

The dependence on concentration and grain size of the following properties of alumina with small ZnO and NiO additives was investigated including the sintering behavior at constant rate of heating, the bending fracture strength at room temperature and 1273°K, the hardness between 1273 and 1873°K, and the electrical conductivity between about 1200 and 1800°K. (GE)

32171 (LA-5151-MS(Suppl.2)) CO_2 GAS LASER STUDIES. Mills, C. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep. 1973. Contract W-7405-eng-36. 46p. Dep. NTIS $4.00.

The numerical solution of the current continuity equations for electrons in dense plasma, and the solution of the equations for laser gain in a gaseous plasma are shown in detail. (auth)

32172 (LA-5331-T) TOTAL ENERGY AS A FUNCTION OF LATTICE PARAMETER FOR COPPER USING THE SELF-CONSISTENT APW METHOD. Snow, E. C. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 129p. Dep. NTIS $5.45.

The X_α exchange approximation is used in self-consistent augmented plane wave (APW) calculations on metallic copper. The α used in the X_α method ($\alpha = 0.7225$) was chosen to yield zero pressure at the experimentally determined lattice spacing. Self-consistent APW calculations were carried out for six different lattice parameters, using this value of α. The total energy as a function of lattice parameter resulting from these calculations was used to determine pressure as a function of lattice parameter, cohesive energy, and compressibility. The cohesive energy for the calculation using the experimental lattice parameter and $\alpha = 0.7225$ was found to be 0.286 Ry, which is within 11% of the experimental value of 0.257 Ry. The compressibility was calculated from two sets of calculated pressures as a function of lattice parameter and was found to agree with the experimental value to within 7% in one case and to within 4% in the other. (auth)

32173 (LA-5391-MS) DIFFRACTION FROM CIRCULAR AND IRREGULAR APERTURES. Judd, O. P. (Los Alamos Scientific Lab., N. Mex.). Oct 1973. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

The specific problem solved is the on-axis intensity resulting from: (1) a uniformly illuminated aperture (phase and amplitude), and (2) Gaussian illumination; the aperture is approximately circular with some small irregularity about an average radius. The theory may also be applicable to tapered apertures that include both phase and amplitude variations. Results are of interest in relation to the problem of self-focusing in solid-state lasers from high-power intensity peaks. (LMT)

32174 (LA-tr-73-45) CORRELATION BETWEEN DIFFUSION ACTIVATION ENERGY, HEAT OF FUSION, AND BINDING ENERGY IN METALS. Kuz'menko, P. P. Translated by A. Vakar from Metallofizika; 42: 37-42(1972). 10p. Dep. NTIS $3.00.

The relations between the heat of fusion, the binding energy, and the diffusion activation energy in metals are established using Grüneisen's theory. (JRD)

32175 (LA-UR-73-1301) PULSED X-RAY IMAGING BY INCOHERENT HOLOGRAPHIC TECHNIQUES. Han, K. S.; Berzins, Donaldson, S. T. (Los Alamos Scientific Lab., N. Mex.). 1973. 15p. (CONF-730930-3). Dep. NTIS $3.00.

From electro-optical systems design conference; New York, New York, USA (18 Sep 1973).

The authors report the use of a Fresnel zone plate (FZP) imaging system for a pulsed x-ray source generated by an intense electron beam, having a maximum electron energy of 600 keV and a pulse width (FWHM) of 3 ns. They also calculate point response functions of an FZP from Kirchhoff's diffraction theory. The calculation shows that, for a given geometry of the imaging system, there exists an optimum number of rings of an FZP. This optimum number will increase the limiting resolution and enhance contrast. The calculations were experimentally verified with optically made FZP holograms. (LMT)

32176 (LBL-1829) X-RAY PHOTOELECTRON SPECTROSCOPY OF SOME NICKEL AND IRON COMPOUNDS. Pont, L. O. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-Eng-48. 35p. Dep. NTIS $3.75.

The x-ray photoelectron spectra of 14 nickel compounds were investigated to determine the nickel 3p and $2p_{\frac{1}{2}}$ binding energies. The data show a general trend of increasing binding energy with increasing nickel oxidation state, but an absolute correlation is not possible without considering the number and electronegativity of ligands and their binding to nickel. X-ray photoelectron spectra were taken of six iron compounds. The iron binding energies appear to depend on the iron atomic charge and on the electronegativity and number of ligands. (auth)

32177 (MLM-2082(tr)) QUESTION OF THE OPTIMAL SIZE OF THE SEPARATING SLIT. Rabinovich, G. D.; Gurevich, R. Ya. Translated from Inzh.-Fiz. Zh.; 22: No. 5, 825-828(1972). 7p. Dep. NTIS $4.00.

On the basis of an earlier developed model of the process of separation in the presence of parasitic convection, recommendations are given to increase the efficiency of liquid thermodiffusion columns. (auth)

32178 (MLM-2083(tr)) THERMODIFFUSION IN LIQUID AND GASEOUS MULTICOMPONENT ISOTOPIC MIXTURES. Rabinovich, G. D.; Ivakhnik, V. P. Translated from Inzh.-Fiz. Zh.; 22: No. 6, 1020-1026(1972). 11p. Dep. NTIS $4.00.

The process of thermodiffusion in isotopic mixtures of titanium, tin, and carbon tetrachlorides has been investigated experimentally. The analysis of the results is given. (auth)

32179 (MLM-2084(tr)) STEADINESS OF CONVECTIVE CURRENTS OF BINARY MIXTURES IN PLANE THERMODIFFUSION COLUMNS. Nikolaev, B. I.; Tubin, A. A. Translated from Prikl. Mat. Mekh.; 35: No. 2, 248-254(1971). 11p. Dep. NTIS $4.00.

The steadiness of the stationary convective flow of a binary viscous incompressible mixture was investigated in relation to normal disturbances by the method of Bubnov and Galerkin in a plane thermodiffusion column. The spectrum of decrements is given for the values of the product of the wave number of disturbances multiplied by Grashof numbers from zero to 2000. The presence of continuous unsteadiness is shown in this flow. The dependence of the critical Grashof number on the number of Prandtl and Schmidt, the wave number and other parameters has been evaluated. The results have been compared with the experimental data. (auth)

32180 (NASA-SP-5958(1)) BIOMEDICINE. A Compilation. (National Aeronautics and Space Administration, Washington, D. C.). [nd]. 30p. Dep. NTIS $4.00.

Developments from the NASA Technology Utilization Program that have potential utility in the field of medicine are described briefly. These include instruments useful in monitoring and treating patients and the development of new material with potential for use in diagnostic, prosthetic, or therapeutic devices. (CH)

32181 (ORNL-TM-4212) PROPERTIES OF SOLUTIONS. Water Research Program Biennial Progress Report for the Period March 15, 1968-March 15, 1970. Raridon, R. J.; Moore, G. E. (comps.) (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 48p. Dep. NTIS $4.50.

The results of a miscibility study in the system pyridine—sulfuric acid-water are summarized. The rest of the report consists of reprints from open literature. (MHR)

32182 (ORNL-tr-2703) ROLE OF CARBIDE PRECIPITATION ON THE CREEP RUPTURE STRENGTH OF THE AUSTENITE FAMILY OF STAINLESS STEEL. Shinoda, T.; Tanaka, R. Translated from Nippon Kinzoku Gakkai Kaiho; 11: No. 3, 180-191(1972). 26p. Dep. NTIS $3.50.

An outline of recent studies is presented on the relationships between the precipitated states of carbides and creep rupture strength. The control of the precipitate dispersion by trace additions of Ti and Nb, and the relationships between the precipitated particles and creep rupture strength is discussed, considering mainly the 18-8 group of stainless steels. (JRD)

32183 (ORNL-tr-2712) FEW PROBLEMS IN ESTIMATING FATIGUE. Nakamura, H.; Kamata, T.; Horikawa, T. Translated from Zairyo; 21: 725-732(1972). 18p. Dep. NTIS $3.00.

Estimating the service life [fatigue strength] of various machinery and construction equipment has assumed great importance and is fast becoming a vital subject. It has been the practice to determine the S-N diagram or the $\sigma = n$ curves (stress-frequency [number of cycles] curves) after which the Miner rule ($\Sigma(n/N) = 1$) is applied to calculate the strength; but many areas of uncertainty need clarification. Experiences in fatigue estimation are described along with explanations. (auth)

32184 (ORNL-tr-2713) CYLIC CREEP RUPTURE IN LOW-CYCLE FATIGUE. Shiratori, E. Translated from Zairyo; 21: No. 227, 720-724(1972). 12p. Dep. NTIS $3.00.

When load-controlled low-cycle fatigue tests at a mean stress increment are conducted, there are instances in which the specimens undergo deformation with repeated cycles, eventually becoming unstable and rupturing. Similar phenomena are observed with deformation in the direction of tensile stress when a cyclic torsional stress is superimposed over a constant tensile stress and in torsional deformation that occurs when a cyclic compressive tensile stress is superimposed over a constant torsional stress. This phenomenon of progressive deformation that accompanies repeated load applications is called cyclic creep, and the resulting unstable rupture is called cyclic creep rupture. Research in this area is discussed, placing emphasis on dynamic stress analysis (numerical). (auth)

32185 (ORO-3262-29) STRAIN RATE SENSITIVITY OF TITANIUM. Garde, A. M.; Reed-Hill, R. E. (Florida Univ., Gainesville. Engineering and Industrial Experiment Station). 1973. Contract AT(40-1)-3262. 19p. Dep. NTIS $3.00.

Aspects of deformation of Ti were studied. It was found that the thermally activated rate controlling deformation mechanism in titanium at low temperatures involves overcoming of the interstitial barriers. Titanium obeys Cottrell-Stokes law when deformation occurs by slip and twinning. A minimum in the strain rate sensitivity-temperature diagram is not a sensitive parameter to measure the extent of dynamic strain aging in a metal. (auth)

32186 (PRNC-169) MOLLUSCICIDAL ACTIVITY OF SOME PLANTS AGAINST THE SNAIL VECTORS OF TREMATODES: SEARCH FOR TOXIC PLANTS, DEFINITIVE SCREENING AND COMPREHENSIVE LABORATORY EVALUATION OF SOLANUM NODIFLORUM AGAINST LYMNAEIDS. Medina-Rodriguez, F. R.; Ritchie, L. S. (Puerto Rico Nuclear Center, Mayaguez). Aug 1973. Contract AT(40-1)-1833. 51p. Dep. NTIS $4.75.

Snail control appears to be the best means of suppressing the transmission of fascioliasis. Results are reported from a search for molluscicidal plants that might be cultured in snail habitats. Among 103 plants screened, 17 were toxic for lymnaeid snails and six notably so. One plant, Solanum nodiflorum, was selected for comprehensive evaluation. Both its roots and leaves were toxic for Lymnaea columella and L. cubensis. (CH)

32187 (PTB-APh-4) NEW THEORETICAL FINDINGS AND PRACTICAL EXPERIENCE WITH THE HOLOGRAPHIC RECONSTRUCTION OF ELECTRON-MICROSCOPIC PHOTOGRAPHS. Hanssen, K. J. (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Jun 1973. 34p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

32188 (RLO-2041-91) SIMPLIFIED THEORY OF X-RAY EDGE IN METALS. Pardee, W. J.; Mahan, G. D. (Oregon Univ., Eugene. Inst. of Theoretical Science). 1973. 4p. Dep. NTIS $3.00.

The Mahan singularity may be derived in a simple way by using the Fermi-Watson-Aizu theorem from scattering theory. This derives a new formula which is useful for frequency-dependent phase shifts. (auth)

32189 (RLO-2226-T-2-4) SOLUTE DRAG AND MEMBRANE TRANSPORT. Progress Report, 1972-1973. Van Bruggen, J. T.

(Oregon Univ., Portland. Medical School). 8 Aug 1973. Contract AT(45-1)-2226. 8p. Dep. NTIS $3.00.

32190 (RT/FI-(73)10) ACCURACY OF EXPERIMENTAL DATA AND SIGNIFICANCE OF THE RESULTS. Agostinelli, M.; Pompa, F. (Comitato Nazionale per l'Energia Nucleare Rome (Italy)). 7 Mar 1973. 67p. (In Italian). (CONF-710987-2). Dep. NTIS (U.S. Sales Only) $5.50.

From conference on modern methods of crystallography; Perugia, Italy (23 Sep 1971).

Usually diffraction data give approximate values of parameters by trial and error or Fourier methods. The final values of the parameters are generally obtained by carrying out a least-squares refinement on intensities or some of their functions and, since the errors in the intensities are rarely less than 5%, the ratio of the number of observations to the number of parameters is much greater than in some other applications. The problem is not linear. A problem of the theory of errors is explained completely by pointing out the most correct statistics and methods to use. The estimate of the absolute error in the measurements, the problem of weights, the theory of linear hypothesis applied to the models, and the formulation of proper accuracy indicators are considered. (auth)

32191 (SC-DR-720858) HIGH-SPEED PHOTOGRAPHIC STUDY OF LIQUID-DOMINATED BLOWOFF. Elrick, R. M.; Miller, D. W. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 43p. Dep. NTIS $4.25.

The effectiveness of high-speed photography was demonstrated by the resolution obtained in defining the kinetics of blowoff in the low-temperature melt region of lead. The large concentration of particles around the filaments suggest that the filaments are a primary source of the particles. The distribution of mass in the plume due to both the particles and the filaments was calculated for an optically thin plume. A profile of the fastest particles at a given location in the plume indicated that either the particles accelerated after formation at zero time or were generated at later times. Two power curves expressing the time history for depositing energy in the target were compared: a square pulse and a more realistic triangular pulse. The triangular pulse reduced the predicted blowoff impulse by 8%, increased the removal depth by 2%, and lowered the front surface velocity by 22% when compared to results from the square pulse. (auth)

32192 (SLA-73-206) MC2810 HIGH-VOLTAGE CONNECTOR CHARACTERISTICS AND DEVELOPMENT REPORT. Konnick, P. J. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. 40p. Dep. NTIS $4.00.

A characteristics and development report is presented for the MC2810 high-voltage, coaxial, plug connector developed for use with Los Alamos Scientific Laboratory aluminum coaxial cable in the W66 Sprint warhead. The use of aluminum conductors dictates that the terminals of the connector be designed to be compatible with welding operations. The design objectives are presented, and the development test program is described. (auth)

32193 (SLA-73-385-B) APPLICATION OF ENGINEERING DATA ON CARBON FIBERS TO CARBON/CARBON COMPOSITES. Butler, B. L. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 52p. Dep. NTIS $4.75.

A compilation of current (3/73) manufacturers' data on carbon fibers for fiber selection is presented. Methods of using these data to aid in fiber selection for carbon fiber/pyrocarbon matrix composites are indicated. The manufacturers' reported properties are defined and tabulated. SEM and optical micrographs are included to give a physical feeling for the fibers. The carbon fiber properties necessary to predict the tensile strength and Young's modulus of carbon fiber/chemical-vapor-deposited (CVD) carbon matrix composites are significantly different from manufacturers' reported data. The effective physical properties of the fibers in the CVD matrix are controlled by strand mechanics and may also be altered by heat treatments. The standard methods for determining fiber properties are contrasted with those needed for carbon composite analysis. Also, a scheme for determining the effects of heat treatment on fiber mechanical properties is presented. (auth)

32194 (SLA-73-683) PACKING CYLINDRICAL MODULES IN CIRCULAR CYLINDRICAL CONTAINERS. Reis, G. E. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 53p. Dep. NTIS $5.45.

A technique has been devised using an iris diaphragm as a circle of variable diameter for experimentally determining the arrangements of cylinders of arbitrary cross section which are the most likely candidates for the array with the densest packing inside a cylindrical container. The method has been used to study the densest packing of N equal circles within a circle for $1 \leq N \leq 25$. An associated problem, namely, the densest packing of N equal circles within a circle, where $N = 1 + 6n$, $0 \leq n \leq 10$, when constrained by 6-fold rotational symmetry, has also been examined. The results are given in the form of tables and figures. Several new patterns are reported. (auth)

32195 (SLA-73-686) EFFECTS OF MICROSTRUCTURE ON THE GRAPHITIZATION OF CVD/FELT COMPOSITES. Granoff, B. (Sandia Labs., Albuquerque, N. Mex.). Jun 1973. 44p. Dep. NTIS $4.25.

The kinetics of graphitization of two CVD/felt composites, prepared by the chemical vapor deposition (CVD) of carbon within carbon felt substrates, were investigated over a temperature range of 2300 to 2660°C and time intervals of 5 to 360 min. Each of these materials graphitized at a more rapid rate than massive chemical-vapor-deposited pyrolytic carbons. The graphitization rates of the CVD/felts were related to the matrix microstructures. The composite which had a rough laminar structure graphitized at two to three times the rate of one with a banded structure. The activation energies of the CVD/felt composites fell within the range (250 ± 30 kcal/mole) observed for a wide variety of pyrolytic carbons and petroleum cokes. (auth)

32196 (SLA-73-709) LASER Q-SWITCHED BY A PLZT SHUTTER. Landry, M. J. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 25p. Dep. NTIS $3.25.

The application of a polycrystalline ferroelectric ceramic $Pb_{1-x}La_x(Zr_yTi_z)_{1-x/4}O_3$ (called PLZT) electro-optic shutter is described for controlling the giant-pulse emission of a ruby laser. The PLZT material had y = 65% and z = 35%, and the value of x was in the vicinity of 8%. Half-wave retardation switching was not available for the PLZT shutter when 10-nsec risetime, 70-nsec-duration voltage pulses (fast Q-switching) were applied. The increased insertion loss, due to less than half-wave retardation, resulted in laser pulse widths about one order of magnitude wider than predicted by fast Q-switching theory which used the minimum insertion loss available for half-wave retardation switching. The observed output power also was one order of magnitude less than predicted. Since the PLZT damaged at relatively low energy and power densities of 0.17 to 0.56 J/cm² and 5.6 to 8.5 MW/cm², respectively, it can be used only as a laser Q-switch at small output power. (auth)

32197 (SLA-73-718) WATER PERMEATION IN SILICONE RUBBER. Kass, W. J.; Andrzejewski, W. J. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. 20p. Dep. NTIS $3.00.

Water permeation has been measured in silica-filled silicone rubber in the temperature range of 25 to 100°C. The permeation rate is 1.2×10^{-10} g/cm-sec torr at 25°C and decreases slightly with increasing temperature. Results of data analysis indicate that the transient approach to steady state permeation does not follow a normal diffusion controlled mechanism, rather that viscous flow may play an important role in this system. (auth)

32198 (SLA-73-756) PREDICTED EARTH ACCELERATION SIGNALS, AND PROSPECTS FOR REMOVING THE INHERENT DISTORTION THROUGH DATA TREATMENT. Overmier, D. K. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 15p. Dep. NTIS $4.00.

This report summarizes results of a study that predicts the response of some typical accelerometers mounted in a buried container which is subjected to earth motion following an underground explosion. Acceleration signal distortion resulting from inherently imperfect earth-to-container coupling is illustrated for acceleration rise times up to 100 microseconds. A procedure for the deconvolution of data, which reconstructs the true ground motion from the distorted signal, is suggested. (auth)

32199 (SLA-73-847) EVALUATION OF LEAK MEASUREMENTS BY THE PRESSURE RISE METHOD. Chamberlin, J. L. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 14p. Dep. NTIS $3.00.

An evaluation is made of the possible sources of error in the pressure rise method of leak measurements. The emphasis is on systems that are operated at pressure. Operation under these conditions can give erroneous results if corrections, that can usually be ignored under vacuum conditions, are not carefully considered. (auth)

32200 (SLL-73-22) WELDABILITY EVALUATION OF SEVERAL PRECIPITATION-HARDENING AUSTENITIC STAINLESS STEELS. Lindsay, P. B. (Sandia Labs., Livermore, Calif.). Aug 1973. Contract AT(29-1)-789. 33p. Dep. NTIS $3.75.

High-purity A-286 alloys were produced and evaluated for weldability. The chemistries departed from that of the conven-

tional alloy in three distinct ways: in the absence of the high-temperature alloying elements, B, Mo, and V; in the absence of the normal impurities, Si, P, and Mn; and in the presence of higher Ti. The weldability, as measured by the study of both the fusion zone and heat-affected zone in electron beam welds, showed dramatic improvement. The work also showed that higher titanium content can be used to work toward the goal of greater strength without injuring weldability if the higher-purity material is used. (auth)

32201 (SLL-73-177-F) FINAL REPORT ON THE GAP AND BARRIER TEST PROGRAM. Rose, W. E. (Unidynamics, Phoenix, Ariz.). 29 Jun 1973. 74p. Dep. NTIS $5.75.

For Sandia Labs., Livermore, CA.

A series of gap and barrier tests were conducted to determine whether a safe-arm device under development would function properly in the armed position when used with a delay detonator and be safe in the safe position. A total of 22 gap tests and 31 barrier tests were conducted, and are described. Based on these tests it is concluded that the safe-arm and detonator configurations are functionally compatible. (auth)

32202 (SLL-73-255) PHASE STABILITY OF IRON-BASE ALLOYS. Baskes, M. I. (Sandia Labs., Livermore, Calif.). Aug 1973. Contract AT(29-1)-789. 28p. Dep. NTIS $3.50.

A model for the free energy of a multi-component alloy is developed. The model parameters for fcc and bcc iron-base alloys are determined by a least squares fit to experimental binary phase diagrams and thermodynamic data. The model is used to predict a multiphase equilibrium diagram and T_o and M_s temperatures for iron-base alloys. (auth)

32203 (SVF-4) LITERATURE EVALUATION OF THE SOLUBILITY OF IRON-CONTAINING CORROSION PRODUCTS. Kelen, T. (Stiftelsen for Varmeteknisk Forskning, Studsvik (Sweden)). Sep 1972. 23p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.25.

A literature evaluation of the solubility of iron-containing corrosion products is presented. It was established that a great number of iron-containing phases may be present during corrosion of steel in water. The presence of such phases excludes the possibility of determining the amount of dissolved iron by calculation of solubility constants for single phases. The only possible way is considered to be experiments in which corrosion products generated under operation conditions are examined after separation by filtration and solubility at different temperatures. (1 table, 7 figures, 42 references) (SW)

32204 (UCID-16337) NUMERICAL SOLUTIONS OF ECOSYSTEM MODELS. Barbieri, J. F.; Pollack, R. I. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Sep 1973. Contract W-7405-Eng-48. 40p. Dep. NTIS $4.00.

Deterministic and stochastic ecosystem models are described in detail, and examples of simple population dynamic models are explored. Such models are usually nonlinear, stiff, and time-delayed. Numerical techniques, in particular the method of Nordsieck and Gear, can be used to solve complex deterministic systems. Similarly Monte Carlo techniques can be used to simulate extremely complex stochastic systems. (auth)

32205 (UCRL-13564) STUDIES OF PHYSICAL AND MECHANICAL PROPERTIES OF POLYMERS. Annual Report, April 1, 1971–March 31, 1972. Baer, E.; Hiltner, A.; Kastelic, J. R. (Case Western Reserve Univ., Cleveland, Ohio. Div. of Macromolecular Science). 1972. Subcontract 5008509. 83p. Dep. NTIS $6.25.

For California Univ., Livermore. Lawrence Radiation Lab.

A series of three projects is described concerning the interrelations between structure and properties of polymeric materials at cryogenic temperatures. The tensile behavior over the temperature range 4.2 to 350°K is reported for polyethylene terephthalate and polycarbonate. The deformation and fracture of biaxially oriented, heat-set polyethylene terephthalate (Mylar A) is also reported at 4.2 to 300°K. The dynamic mechanical relaxation behavior (1 cps) of two series of amorphous polyolefins, $-(CH_2)_mC(CH_3)_2-$ and $-(CH_2)_mC(CH_3)(CH_2CH_3)-$ where m = 1,2,3, is examined from 4.2°K to the glass transition. (JRD)

32206 (UCRL-51413) SIMPLE APPROACH TO LASER AMPLIFIERS. Trenholme, J. B.; Manes, K. R. (California Univ., Livermore. Lawrence Livermore Lab.). 28 Nov 1972. Contract W-7405-Eng-48. 23p. Dep. NTIS $4.00.

A mathematical description of a laser amplifier is presented in a simplified way. The gain is described by rate equations. Neither diffraction nor cross-relaxation is considered. The transfer properties of the amplifier are analyzed, and its effects on the spatial and temporal pulse shape are described. It is shown why operation at more than 5 or 10 times the saturation flux is undesirable unless the resulting pulse distortion can be accepted. This report is a consolidation and review of known results, and a study of their implications for laser amplifier design. (auth)

32207 (UCRL-51432) PHENOMENOLOGICAL SURVEY OF EXPERIMENTAL DETERMINATION OF TEMPERATURE OF SHOCK-HEATED SOLIDS. Urtiew, P. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jul 1973. Contract W-7405-eng-48. 33p. Dep. NTIS $4.00.

The technique for measuring the temperature of solid, nontransparent materials under shock-loading is being discussed. The problem is very complicated, and it is important to understand its various implications and its useful features. Therefore, a phenomenological survey is presented of various aspects of this problem, leading to a short summary of what experimental measurements can be and already have been made with this technique, and the reliability that can be expected. (auth)

32208 (UCRL-74383) SUBSTRATES AND COATINGS: UNDERSTANDING CONVENTIONAL DEPOSITION TECHNIQUES IN THE FACE OF INCREASED SOPHISTICATION OF APPLICATIONS. Brunner, W. F.; Khan, J. M. (California Univ., Livermore. Lawrence Livermore Lab.). 16 Jul 1973. 10p. (CONF-730325-2). Dep. NTIS $3.00.

From annual meeting on society of vacuum coaters; Chicago, Illinois, USA (28 Mar 1973).

Demands in the fields of electronics, materials development for space, and optical coatings for lasers have produced a distinct increase in the sophistication of vacuum coating applications. Problems arise because the coatings have unique properties, not shared with the bulk material, and sometimes react with other materials in the deposition process in ways unpredictable by extension of practical experience. Methods of analyzing these effects have been limited in their application. (auth)

32209 (UCRL-74836) ONSAGER RELATIONS: EXPERIMENTAL EVIDENCE. Miller, D. G. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Jul 1973. 39p. (CONF-730724-1). Dep. NTIS $4.00.

From international symposium on the foundations of continuum thermodynamics; Bussaco Forest, Portugal (22 Jul 1973).

The Onsager Reciprocal Relations (ORR) are a postulate of a linear thermodynamic theory of irreversible processes. This postulate states roughly that the matrix of linear coefficients L between properly chosen "flows" J and "forces" X is symmetric, i.e., $L_{ij} = L_{ji}$. The concept of "proper choice" has been criticized and is briefly discussed. Many phenomena are linear in the normal ranges of "force" variables, such as diffusion, thermal diffusion, transport in electrolyte solutions, heat and electrical conduction in solids, electrokinetic effects, and thermogalvanomagnetic effects. Appropriate experimental evidence in these cases is reviewed, including recent experiments. The conclusion is that the ORR are valid within acceptable error limits. Workers in continuum mechanics are challenged to find by their rigorous methods the macroscopic origin of this fundamental symmetry principle. (auth)

32210 (UCRL-Trans-10702) GALVANIC DEPOSITION OF GOLD–COPPER ALLOY. Zuntini, F. Translated from Oberflaeche-Surface; 13: No. 11, 31a-33a(1972). 15p. Dep. NTIS $3.00.

Development of processes for electrolytic deposition of gold alloys is reviewed. Methods of tinting by use of Cu, Ni, and Ag are summarized along with a series of patents issued during the period 1914 to 1969 concerned with the processes. (JRD)

32211 (UCRL-Trans-10704) ELECTRON SCATTERING IN SEMICONDUCTORS OF TYPE n–InSb. Aliev, T. A.; Gashimzade, F. M. Translated from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 4, 98-101(1970). 9p. Dep. NTIS $3.00.

The probability of electron scattering on acoustic phonons, optical phonons, and ionized admixture atoms has been calculated. In the calculation of the matrix element for the scattering an allowance was made for the specific symmetry of the wave functions of the electron with spin, and also for the effect of screening by the current carriers during the scattering on optical phonons. An attempt was made to allow for the influence exerted by the nonparabolic character of the energy spectrum of the electrons on the matrix elements for the interaction of an electron with phonons and ionized impurities in semiconductors. (auth)

32212 EIGHTEENTH SCIENTIFIC MEETING OF THE ITALIAN GENETIC ASSOCIATION, PAVIA, ITALY, SEPTEMBER 21–23, 1972. Atti Ass. Genet. Ital.; 18: 1-119(1973). (In Italian). (CONF-720999-(Absts.)).

Abstracts are presented for 46 papers presented at the meeting of the Italian Genetic Association, September 21 to 23, 1972. English translations are included for most of the abstracts. Topics covered include studies on the genetics of human populations, maize, algae, and bacteria. (CH)

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